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CONTENTS.

Editorial - - - - - - - - - - - - - - 167
American Association for the Advancement of Science - - 169
British Association at Oxford - - - - - - - - - - 171
Association of Edison Illuminating Companies - - - - - 172
Dynamo-Electric Machines, by E. J. Houston and A. E. Kennelly 174
Action of a Transformer with a Condenser in Parallel with the Secondary—II., by F. Bedell and A. C. Crehore - - - - - 176
Sine Form of Curves of Alternating E. M. F., by H. J. Ryan and C. P. Steinmetz - - - - - - - - - - - - - 177
Symbols for Physical Quantities and Abbreviations for Units - 179
Digest of Current Technical Electrical Literature, compiled by Carl Hering - - - - - - - - - - - - - - 180
A New Incandescent Lamp - - - - - - - - - - 182
High Tension Cut-Outs - - - - - - - - - - - 182
The Wenstrom Dynamo - - - - - - - - - - - 183
New Electrical Devices - - - - - - - - - - - 183
Automatic Oiling System - - - - - - - - - - 184
Storage Batteries of Large Capacity - - - - - - - 185
New Book - - - - - - - - - - - - - - - 185
DEPARTMENTS:
Financial Intelligence - - - - - - - - - - - 186
Special Correspondence - - - - - - - - - - - 186
News of the Week - - - - - - - - - - - - 188
Trade and Industrial Notes - - - - - - - - - - 188
Business Notes - - - - - - - - - - - - - 189
Illustrated Record of Electrical Patents - - - - - - - 189

THE OLD AND THE NEW.

The Marquis of Salisbury in his presidential address before the British Association at Oxford illustrated the past and present relations of Oxford University toward modern science by comparing the warm reception of the Association in the present year with the one it experienced at its first meeting in the university town, in 1832. Then there was an entire lack of sympathy, and even the gentle spirit of Dr. Keble, the leader of thought in the university, was sorely vexed at the bestowal of the honorary degree of D. C. L. on four members of the Association, and he indignantly complained that the "Oxford doctors have truckled sadly to the spirit of the times in receiving the hodge-podge philosophers as they did"—the "hodge-podge" philosophers being Faraday, Brewster, Dalton and Brown! The same spirit had not yet departed in 1860, at the last previous meeting of the Association in Oxford, but this time it was the scientists who adopted the superior tone and were active aggressors. At the meeting just closed the relations of the old antagonists, according to the Marquis of Salisbury, were "those of entire sympathy and good will, as becomes common workers in the sacred cause of diffusing enlightenment and knowledge."

ELECTRICAL SYMBOLS, ABBREVIATIONS AND UNITS.

As a useful reference table we reprint elsewhere the symbols, notation and abbreviations recommended for international practical use by the Committee on Notation of the Chicago International Electrical Congress, and ordered printed as an appendix to the general report of the Chamber of Delegates; to which has been added, in italics, the names of the provisional practical magnetic units adopted by the American Institute of Electrical Engineers. The value of uniformity in notation, symbols and nomenclature is so obvious to all that it is needless to dwell upon it, and it is not too much to say that even a very imperfect system would be much better than none at all. That of Professor Hospitalier is the result of years of study and criticism, and, as will be noted, introduces few, if any, radical changes from the usage of the best writers of all countries. While some points may possibly be open to criticism from a special point of view, investigation in regard to these would in every case, we think we can say with assurance, develop sufficient reasons for their justification. It should be borne in mind that such a system, devised for use in all languages and for general application, cannot reasonably be expected to exactly satisfy the conditions of theoretical perfection for every case that may come under it. In the present instance the compromises have been made by one eminently qualified, from his practical and theoretical attainments, judicial temperament and cosmopolitan breadth of view, to weigh all of the considerations involved. The table as finally presented to the Congress only received its definitative form after some years of criticism invited from international sources, and therefore may safely be accepted as possessing in the highest degree possible the requisites necessary for general and international use. The favorable reception which the new magnetic units have received renders it extremely probable that the next international electrical congress will give its official assent to the names adopted, as the recent one did to the henry. Like the henry, too, they are of American origin, and while science knows no country, yet this fact offers an additional argument why American electricians should receive them with favor. Once thoroughly established in this country they cannot be disregarded by the electricians of other countries, though it may be remarked, no evidence of disfavor has been manifested abroad, but, on the contrary, the comments have shown the opposite spirit.

ECONOMIC AGE OF INCANDESCENT LAMPS.

Under the above caption the Digest gives an abstract of a recent article in L'Industrie Electrique on the "smashing point" of incandescent lamps. We cannot at all agree with the statement that it requires an experienced eye to detect a drop of 20 per cent. in the candle power of a lamp; if the filament is at a very high degree of incandescence when new—that is, if the lamp is one of high efficiency—the drop is more difficult to detect, as the "fatness" of the filament is not as much decreased, but even in this case a user in time would easily recognize the difference. It is well to point out that the calculations for the "smashing point" of a lamp rest upon the assumption of a necessity for a constant intensity of illumination. This is a condition that is ordinarily not demanded, as usually a diminution in the intensity of a considerable amount will have little practical importance. To be sure, as lamps age the illumination will diminish, but as long as it remains sufficient there would be no economy in "smashing lamps," particularly as the current is also reduced, though not in as great a proportion as the light. A question of prime importance, however, in the economical use of lamps, is that relating to the efficiency at which they should be used, or, in other words, the intensity of the incandescence of the filament. The higher this incandescence is carried the shorter will be the life, but, on the other hand, the lesser the energy will be for a given quantity of light. The factors that enter into the question of efficiency are the cost of the lamp and of the electrical energy used, and the rate of variation of the candle-power with the watts supplied to the lamp and with the life of the lamp. Of these factors the first two are, of course, known in every case; the third is well established, and the fourth has been determined by some lamp manufacturers. A practical method of arriving at a solution would be to raise or lower the voltage, where this is practical, of the circuit without varying the voltage of the lamps, or by varying the voltage of the lamps, that of the circuit remaining constant. By noting the effect on the total cost for illumination, the most economical age might thus be determined. In general it may be said that where the power is expensive, lamps may be used considerably above their normal voltage with economy, and vice versa. The former is the condition where current is taken from a central station, and it would be worth the while of consumers thus supplied to experiment with lamps somewhat below the voltage of the circuit, and note if the lower meter bill will not more than compensate for increased breakages. Where, however, electric power is cheap, as in isolated plants, it will be best to buy lamps of a voltage higher than that of the circuit, and thus insure a longer life. One engineer of whom we know recommends for this case the purchase of 20 candle-power lamps of several volts above that of the circuit, the candle-power thus being reduced to about 16. It will be seen that the life of a lamp is far from being the controlling factor in the question of economy; for every set of conditions there is a definite life, and if this is prolonged by the filament being used at a less incandescence than corresponds to this condition, there is a loss which becomes greater the longer the life. Therefore, instead of being satisfied with lamps having a long life, the contrary should be the case. Central station managers have an additional interest to promote this efficient condition, for the sickly light given out by aged lamps is not apt to increase confidence in electric lighting.

ENGINEERING EDUCATION.

The address of Prof. Kennedy before the Mechanical Science Section of the B. A., on "The Critical Side of Mechanical Training" is of especial value at the present time when there seems to exist so much difference of opinion in regard to the methods of technical education. His definition of an engineer and enumeration of the nature of the duties he is called upon to perform are so apt that we quote the entire passage, which is the key-note of the address: "An engineer is a man who is continually being called upon to "make up his mind. It may be only as to the size of a "bolt; it may be as to the type of a Forth bridge: may "be as to the method of lighting a city; or only as to the "details of a fire-grate. But, whatever it is, once it is settled it is "decided irrevocably—it is translated into steel and iron and copper, "and cannot be revoked by an act passed in another session. The "time given him in which to decide may be a day or a month, "or year, but in any and every case (so far as my own experience "goes) it is about one-tenth part of the time which he would like "to have. It is only in rare cases that the decision is obvious—most "often there are courses more open than even the most facile politician ever dreamt of. The matters are too complex to be dealt "with mathematically or even physically; even if they were not, "there are few engineers who would have the special capacity to "handle them. Moreover, their solutions are seldom "unique." "From this point of view, the whole use of college training, of "workshop practice, of practical experience, is to provide the "engineer later on with the means of critically examining each "question as it comes up, of reviewing systematically the *pros* and "*cons* of each method of dealing with it, of coming finally, "rapidly and positively to some defensible decision, which "may then be irrevocably carried out." Stress is laid upon the desirability of imparting to engineering students the power of literary expression, and regret expressed that so little attention has been given to this point. Some of our American technical schools are particularly deficient in this respect, and we recall the statement of an eminent engineer that he could always recognize from the illiteracy of their writings the graduates of a certain well-known technical school. It is pointed out that the power of expression carries with it the idea of clearness and consecutiveness of thought, so that, in this broader sense, the matter involves more than the teaching of literary style, and is also connected with the development of the fundamental sense of proportion, upon which stress is laid throughout the paper. Prof. Kennedy draws a distinction between physical and engineering laboratories in the statement that the aim in the former is to make all problems as simple as possible, to eliminate all disturbing influences or elements, and to obtain finally a result which possesses the highest degree of accuracy. The business of the engineer, on the other hand, is to deal with physical problems under conditions that he can only partially control, and which are a part of his problem. The work in the engineering laboratory, therefore, should be in quantitative and relative measurements, rather than in absolute ones, and made to a great extent with the complicated conditions present under which the actual final result has to be obtained. The question as to whether there is any general standpoint from which mechanical criticism may be directed is shown to be so involved as to admit of no perfectly general answer, but as a near approach Prof. Kennedy offers a criterion to apply to any scheme, system or machine, which is that the absolutely best in any particular case is that which will longest survive and maintan its place in its particular environment. The views of Prof. Kennedy on engineering education may be resumed in the statement that it should consist most largely in the development of the judgment, and therefore problems should be studied under the complex conditions met with in practical work and not divorced, for the sake of more absolute accuracy, from these conditions. How much of mathematics and pure physics should be taught and in what manner, are subjects which are not taken up except to point out that the attitude of mathematicians and physicists in demanding that these branches shall be exhaustively taught is unreasonable, as their importance in an engineering course must be rated by an engineering and not purely scientific standard.

High vs. Low Tension.

In Germany recently one man was killed and another injured by an electric current, the latter being awarded damages while the former was not; this would appear to be an argument, at least in Germany, for the use of high tension circuits, as it appears to be cheaper for the companies to kill outright than to injure persons.

ANNUAL MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The opening sessions of the forty-third meeting of the American Association for the Advancement of Science were held last week, beginning on Thursday, August 16, at the Polytechnic and Packer Institutes in Brooklyn.

The opening exercises were held in the chapel of the Polytechnic. William Harkness, the retiring president, called the meeting to order and introduced Dr. Daniel G. Brinton, the president-elect.

Dr. Truman J. Backus, president of the Packer Institute, delivered the address of welcome, in the absence of the Mayor, and dwelt particularly on the educational features of Brooklyn. President Brinton replied in a happy vein.

After the general session the several sections met and organized by the election of officers and committees. Three out of the nine vice-presidents elected at Madison last year were absent, and their places were filled by electing Edgar Frisbie in section A (astronomy and mathematics), J. H. Lintner in section F (zoology), and C. I. Bessey in section G (botany).

The addresses of the several vice-presidents occupied the afternoon. Eight in all were delivered, two of the absentees having sent on their manuscripts. Section A had a valuable paper from George C. Comstock on "Binary Stars," in which he gave the latest results of his own and others' investigations and computations in this very important and progressive department.

Vice-President William A. Rogers read before Section B (physics), an address on "Obscure Heat as an Agent in Producing the Expansion of Metals Under Air Contact," giving an exhaustive demonstration of a subject which he is peculiarly qualified to discuss.

PRES. D. G. BRINTON.

Thomas H. Norton addressed Section C (chemistry), on "The Battle With Fire." The loss of insured property, he states, is $200,000,000 annually, of which nearly one-half occurs in the United States, amounting to one fifth of all the net profits of the industries of the country. Eighty or ninety per cent. of the 15,000 annual fires in the United States are due to preventable causes, mostly faults in the construction of buildings. The fire department of London costs but one-third as much as that of New York. Preventive measures were recommended, calling in the activity of the chemist, notably in the way of apparatus and equipment for supplying carbon dioxide. Silicious paint was also recommended. The increased use of aluminum instead of wood wherever practicable in building was another preventive measure commended.

Vice-President Mansfield Merriman delivered a very able address before Section D (mechanical science and engineering), on "Paradoxes in the Resistance of Materials."

Vice-President Samuel Calvin's address to Section E (geology and geography), was on "Some Points in Geological History Illustrated in Northeastern Iowa." He dwelt upon the Niobrara chalk deposits, and exhibited what seems a novelty, genuine American chalk of commercial value.

Lucien M. Underwood sent to Section G an address on the "Evolution of the Hepaticae," a subject which he has made a specialty.

The anthropological address by Franz Boas, as usual, aroused popular interest. He spoke on "Human Faculty as Determined by Race."

Henry Farquhar read to the Economic Section (I) a very exhaustive treatise on "A Stable Monetary Standard."

In the evening the retiring President, Prof. Harkness, delivered his annual address in the Academy of Music, on the "Magnitude of the Solar System." He expressed the opinion that recent improvements in telescopes have added but little to the accuracy of measurements of solar parallax, and that the various other methods of determining the sun's distance were nearly as effective early in the century as they now are. A mass of observations has already accumulated, which, by careful calculation and compilation, comparing the results of different methods, will give a nearer approximation to the truth than any one observer could reach by unaided observation with the more refined instruments.

A very brilliant reception in the Art Building followed the evening address. The Ladies' Reception Committee had provided beautiful decorations, and the Entertainment Committee an elegant lunch.

Friday was devoted to the reading of papers in the nine sections, eighty-eight papers having been put upon the programme. In the evening Paul B. Du Chaillu lectured on "The Viking Age." The work of sections A, B and D is given in abstract below.

It is not alone the younger members of the association, on pleasure bent, who hail with delight the relief of Saturday's excursions in place of the formal sessions. The field meetings prove interesting and instructive to all by bringing them into closest communion with nature. Four different steamers conveyed the scientists in different directions. One, carrying the largest party, went to Cold Springs, whence the geologists took boats to Great Neck to study the folded clay beds of the tertiary age, which are unusually fine there; the biologists went by steam launch to the biological laboratory and fish hatching station, and the botanists tramped through the forests in search of specimens. The chemists embarked for the Standard Oil Works at Bayonne, N. J., and Balbach's Smelting Works and Feigenspan's Brewery at Newark. The United States government furnished the steamer Fish Hawk for a dredging excursion, and a small party boarded her at Tompkinsville, S. I., and steamed out to the Cholera Banks. The entertainment of the day, however, was the excursion to Long Branch. Two or three hundred members of the association, and invited guests, taking the steamer Aurora at Fulton Ferry, were conveyed to Battery Pier, thence by the "Mary Patten" to Pleasure Bay, and thence to the residence of Mrs. Esther Herrman at West End, where a bountiful lunch was provided. The surprise of the day, however, was when souvenirs of solid sterling silver designed by Mrs. Herrman herself were given the guests, consisting of badges, shaped like a scallop shell upon sea weeds, surmounted by the legend "Progress," with the lamp of science above all. The badge was lettered in blue "A. A. A. S., 1894."

SECTION A—MATHEMATICS AND ASTRONOMY.

Mr. Geo. E. Hale opened the proceedings in this section by his interesting paper on "Some Attempts to Photograph the Solar Corona Without an Eclipse." Hale first failed from the great direct effects of diffused light, but decided to try again on Pike's Peak. In his ascent he found that the sky increased in depth of blue very perceptibly as the altitude increased. The advantage of elevation was very evident. But before he could get ready to try, great forest fires filled the atmosphere so as to spoil the favorable conditions, but at least he had the great satisfaction of getting no false corona, as all others had done. It was then suggested to try on Mt. Etna where there was already a telescope mounted. The apparatus was now much improved and tried on the moon, for parts of the moon are fully as bright as the corona. A semi-exposure of 40 seconds was used. But on Mt. Etna the driving clock stopped in a most exasperating manner in the midst of the exposures, and again the experiments were not successful. As a summing up of all, it can only be said "that the apparatus has not had a fair trial."

Mr. G. W. Hough then presented again a method of control of the Equatorial driving clock, which was published in the transactions of the Albany Institute in 1871. Mr. Clark rose to say that it had been used in Harvard for ten years and he supposed it to be

due to his own brother or to Pickering. Where this method is applied a clock will go all night without variation, and will watch the telescope better than the observer himself.

Next, W. R. Warner, in his paper on "Requisites for Governing the Motion of Equatorial Telescopes," told of the differing resistance produced by weather oil or the lack of it, etc., which yet the clock must overcome and still run accurately. To do this there must be a large excess of power. The problem is difficult but can be solved. Prof. Young, of Princeton, makes the beat practically isocronous by a varying angle which leaves the length of the pendulum always practically the same. This is used in the new 26-inch glass of the Naval Observatory, and is so perfect that electric control is not needed except for photography. Another method is based on the principle of the tuning-fork, which vibrates in the same time whether the beat be long or short. What is needed is excess of power and a mechanism to absorb evenly this excess of power.

Prof. Doolittle exhibited a large diagram picturing the results of the recent latitude determinations at the Sayre Observatory, of South Bethlehem, Pa. The Chandler theory and these observations differ so much that one can hardly be called an approximation of the other. Prof. Doolittle finds a diminution in the mean value of the latitude, which is entirely unaccounted for.

Mr. H. M. Parkhurst, on "Stellar Photometry," said that the two chief sources of error came from the difference in brightness of the evenings when the photographs are taken, and from the mis-identification of stars.

"An Extension of the Gaussian Potential Theory of Terrestrial Magnetism" was the subject of an interesting paper by L. A. Bauer. In the course of terrestrial magnetic investigations the question came up whether the potential of terrestrial magnetic force at the earth's surface could be derived, according to the Gaussian potential theory of terrestrial magnetism, for epochs where force observations are wanting and but observations of declination or of inclination or of both were at hand. If this potential could be derived say for epochs 1,600, 1,700, etc., up to the present time, a secular variation term might be introduced in the Gaussian potential expression and thus an expression obtained which would permit the drawing of approximate magnetic charts for any time during the interval for which the formula had been established, and various other interesting questions answered, as e. g.: What is the orbit described by the magnetic pole in the course of centuries? As the poles are the points of the earth's surface where the potential world has a maximum or a minimum value, by subjecting the potential to this condition the points might be located for any particular epoch. The question above has been partially investigated and affirmatively answered. A mathematical demonstration was then presented. How practicable the method is can only be determined by trial The trial can, however, not be made at present for want of force and time. The sole purpose has been to show that theoretically the solution of the question propounded above is possible.

Section B.—Physics.

In this section the first paper presented was by Prof. W. S. Stevens, in which he developed further a new mode of steroscopy, employing a pair of perfectly similar diagrams, of which the binocular combination is made to appear convex or concave at will by verging the relation between the visual lines and the planes of the two halves of the stereoscope to be exhibited.

A paper by A. Springer, of Cincinnati, on "Aluminium Violins" was next read. The quality of the tone is different according to whether the back and belly of the instrument are strengthened by arching and ribbing.

W. Hallock, of Columbia College, read a paper in which he showed that a photographic record of the behavior of manometric, or other jumping flames, is obtained by rotating the whole camera—an entirely new method.

A paper by Prof. E. L. Nichols on "A New Form of Spectrophotometer" described an instrument to compare two sources of light by comparison of spectra.

"The Thermal Conductility of Cast Iron," was considered in a paper by J. T. Osmond. He found the conductivity to be greater the higher the temperature. Forbes' method was used, but the results were notable as being the reverse of Forbes' for wrought iron.

A paper by R. W. Quick and B. S. Lamphear took up the "Normal Conductivity of Copper at Low Temperature." The Forbes method was employed. The conductivity was found to decrease as the temperature decreased.

Mary C. Noyes considered "The Influence of Heat and Electricity Upon Young's Modulus for a Piano Wire." The work was done in the Physical Laboratory of Cornell University under the direction of Prof. Nichols. The wire was heated by a current sent through a magnetizing coil surrounding the wire, thence though a non-inductive coil, and then through the wire itself. There was no effect from magnetization. Passing the current through caused the modulus to become larger. but the effect was irregular.

The next paper was by Prof. E. L. Nichols and Mary C. Spencer on "The Influence of Temperature Upon the Transparency of Solutions." The instrument used was the horizontal slit photometer and the source of light two incandescent lamps, the light coming from one direct and from the other through the solution. The solution was heated by an electric current. Different wave lenghts were compared at different temperatures with the following results: (1) In the case of water up to 80 deg. C. there was produced no change in the transparency for any portion of the visible spectrum. (2) Other solutions showed a diminution of transmitting power throughout the entire spectrum. (3) Certain solutions diminished for certain regions of the spectrum, but not for others.

Prof. Nichols and Mary L. Crehore in a paper on "Studies of the Lime Light" (presented also at the British Association this year) treated on the changes in the radiation in the tricad line cylinder of Drummond light from the moment of ignition to the final state of incandescence a spectro-photometer was used.

"On the Directed Velocity of the Particles in the Electric Arc," was the title of an interesting paper by Prof. B. W. Snow, of the University of Madison. The plan followed in this determination consisted of projecting on the slit of a spectrometer the image of the arc, viewed end on, and of observing any displacement of the spectral lines due to the motion in the line of sight. To accomplish this end two carbons were bored out longitudinally, these placed horizontally in line with each other, and connected with an alternating electric light circuit. In the core of the carbon farthest removed from the spectrometer was laid a piece of iron wire, which volatilized and filled the arc with iron vapor and yielded a brilliant iron spectrum. The light from this arc, passing through the hollow core of the nearer carbon, was projected upon the spectrometer slit. The luminous spot thus formed, consisted, therefore, of intermittent flashes produced as the discharge in the arc approached the instrument or receded from it. The light entering the slit was studied in the spectrum of the third order produced by a grating of 14,000 lines to the inch. It was expected that if the gaseous particles in the arc had a directed velocity, the lines would have been displaced in opposite directions, as the discharge approached or receded, and therefore the lines would appear doubled or at least broadened. Although a displacement equal to the one-hundredth part of the distance between the D lines could have been detected, no trace of such doubling or broadening occurred, and the lines throughout the spectrum appeared perfectly sharp. Had the lines appeared double by this amount, the velocity of approach would have been not far from a mile per second. Inasmuch as no velocity of this amount was observed, it is believed the directed velocity of the particles in the arc to be less than one mile per second, and therefore the temperature of the arc cannot be calculated from the directed velocity of the particles.

Section D—Mechanical Science and Engineering.

The first paper was on the "Crank Curve," by Mr. J. H. Kinealy, secretary of the section. In this paper a simple graphical method was given for determining the velocity of the piston of a steam engine for a given position of the crank. A curve was constructed so that the ordinates measured between it and the crank circle were proportional to the velocity of the piston. Prof. Kinealy has named this curve "the Crank Curve" and has developed several interesting properties relating to it, such as a method of determining the point of the stroke at which the crank-pin and piston of an engine have the same velocity.

The next paper was on preliminary experiments on a new air pyrometer for measuring temperatures as high as the melting point of steel, by D. S. Jacobus. Experiments made at the Stevens Institute show that three pyrometers gave concordant results in measuring very high temperatures. The pyrometers were placed in a special furnace and were gradually brought to a maximum temperature and were held at this maximum temperature for several hours. This has been done a number of times, and the readings of the pyrometers were found to agree with each other, thus showing that concordant readings are given at extremely high temperatures, and that the pyrometers are unaffected by heat as high as the melting point of steel.

A second paper by Prof. Jacobus was on the "Precautions Necessary in the Use of Mercurial Thermometers in Determining the Amount of Super-heat in Steam." The method recommended for measuring super-heat was to read the thermometer when acted on by saturated steam at a given preasure and subtract this reading from the reading when the steam is super-heated. This method eliminates various errors such as that produced in not heating the mercury in the stem of the thermometer. The steam tables also give the temperatures measured by an air thermometer, and there is a correction which must be applied to reduce to readings by a mercury thermometer.

A third paper by Prof. Jacobus was on "Improvements in Methods of Testing Automatic Fire Sprinkler Heads." Automatic fire heads for extinguishing fires have now come into common use. In these a valve is opened automatically in case of fire by the belting of a fusible solder piece and the water from this valve extinguishes the fire. The method of making tests on such heads was described in detail. The tests now made are much more complete than the first tests, for the reason that, as time passed on, and the action of the sprinklers could be noted after several years of actual service, various defects were developed. The present tests are made to cover, as nearly as possible, all features where defects have been noticed, and for this reason the requirements of a successful head are much more severe than in the first test. The various causes of failure and the requirements of a successful head were fully described.

A paper by Prof. J. E. Denton was next read on the "Ratio of the Expansion of Steam in Multiple Expansion Marine Engines for Maximum Economy in Fast River Steamers." This paper demonstrated by numerical examples that in fast river steamers the use of the ratio expansion affording the least consumpton of steam per horse power requires a greater consumption of fuel for a given amount of transportation than the use of engines using lower ratios of expansion and consuming correspondingly greater amounts of fuel per horse power. A chart was exhibited showing the calculations in detail for a specific case.

Next followed a paper by Samuel Marsden on "Experiments on the Transverse Strength of Long-leaf Yellow Pine." The results of numerous experiments were presented. The conclusions derived from the experiments are that the breaking strength of the pieces from nine trees vary so that some results are twice as high as others. Experiments on similar pieces having the same number of layers to the inch, taken the same distance from the centre of the trees, show an increase of strength of about 20 per cent. after being seasoned. As a rule the greater the number of layers to the inch the stronger the timber will be, no matter from which part of the tree it has been taken.

The last paper presented at the meeting was by Elmo G. Harris on "The Air Lift Pump." Elaborate mathematical deductions were presented which show that under the assumed conditions about one quarter of the energy applied to the air is lost on account of the flow of water backward past the air bubbles. The formula derived applies to pumps say five or six inches in diameter. In small pipes the bubbles may fill the pipes and act as pistons of air, and in this case there would be a greater efficiency, neglecting friction, than in the case of larger pipes.

Of the affiliated societies which have thus far met, the only one whose proceedings are of interest to the electrical public is the American Mathematical Society, which met on August 14 and 15. Dr. Emory McClintock presided. About thirty mathematicians from different parts of the country were present. Dr. McClintock, in his address, said that the name of the society had been changed from that of the New York Mathematical Society to the American Mathematical Society, and the change was a successful move. Some eminent mathematicians were now ready to join who would not join before. The society had been successful in bringing together the mathematicians of the country, and in encouraging original research, but it had not yet provided for the proper publication of papers presented to it. How to remedy this defect was being considered. The programme included papers by Dr. Emory McClintock, Profs. Alexander Macfarlane, Frank Morley, E. Hastings Moore, George Bruce Halsted, R. S. Woodward, V. Schlegel, Artemas Martin and Henry S. White.

Molecular Energy.

According to G. F. Fitzgerald, a hydrogen molecule moving with the velocity of light has an energy of less than half a millionth of an erg.

BRITISH ASSOCIATION MEETING AT OXFORD.

The meeting of the British Association at Oxford, as was stated last week in the cablegram from The Electrical World's special correspondent, was opened on Wednesday, August 8, and, as had been expected, the papers and discussion were of great interest. The meeting was formally opened by the address of its president, the Marquis of Salisbury. He referred to the ignorance from which we suffer from a scientific standpoint, and the mysteries which surround our investigations. This century has witnessed determined and often very successful attempts to penetrate the unknown, but with the result only to extend a little the boundaries of knowledge. The nature and origin of the elements is still an unsolved problem. Many brilliant scientists have attacked it, but our knowledge in this direction still remains almost where it was centuries ago. The ether, Lord Salisbury went on, was another thing which baffled scientists. He spoke of it as a half-discovered entity, believing it to be an exaggeration of our knowledge to call it a body, or even a substance. One of the most brilliant services of Maxwell was the discovery of the relation between the velocity of light and the electric impulse. Still, nothing is known of this all-pervading entity except that it can undulate, and even this function is performed in an unusual fashion. Instead of undulating backwards and forwards in the path of its own advance, ether undulates athwart the path of the wave's advance. The genius of Lord Kelvin has recently discovered what he terms a labile state of equilibrium in which a fluid that is infinite in its extent may exist, and may undulate in this eccentric fashion without outraging the laws of mathematics. However far this may go towards the solution of the problem, it still leaves our knowledge of ether in a very rudimentary condition.

Prof. Rucker delivered a very able presidential address to Section A. He first called attention to the spread of scientific education. This, he stated, was well illustrated by the fact that it is within about thirty years that mathematics and physics have been recognized as wide enough to require more than one teacher, the first professorship of natural philosophy being established at Owen's College, Manchester, in 1860. It is also only about a quarter of a century ago that the Clarendon Laboratory (in which some of the present meetings are being held), the first laboratory in England specially built and designed for the study of experimental physics, was erected. He emphasized the importance of investigation and research, and regretted its assignment to a secondary position in the popular mind. Oxford had happily established within the last year a research degree. After calling attention to the recent evidences of private munificence for the advancement of learning, and to the difficulties now encountered by scientific workers in securing the publication of their papers and books, Prof. Rucker proceeded to the main subject of his address—the practical and theoretical study of terrestrial magnetism. He first drew the attention of the section to the necessity for a full primary comparison between the standard magnetic instruments in the different observatories. In his investigations during the past ten years he found that instruments for measuring the declination and horizontal force are affected by errors far greater than the errors of observation, the discrepancies often being most startling. In the second place, if conclusions have to be drawn from the minor differences between measurements of secular or diurnal change made in the observatories, it is not only necessary to know whether the instruments are strictly comparable and constant, but observations must be reduced by the same method. It is well known that the average daily oscillations of the magnet are affected by the magnetic weather. Accordingly, arrangements have been made for the English magnetic observatories to determine the diurnal variations for particular days when there were no magnetic disturbances. Prof. Rucker also suggested that the Astronomer Royal and Prof. Mascart might agree in their choice of days for the calculations so that there might be an exact similarity of method between the English and French observatories. He also stated that co-operation in the institutions was essential, and hoped that in time a "British Magnetic Year Book" might be produced. He then discussed the modern theories

of the phenomenon, citing important observations made by different observers, considering local disturbances, etc. Two causes of regional and local disturbances have been suggested, viz., earth currents and the presence of visible or concealed magnetic rocks. The two theories are not mutually exclusive. Both causes of the observed effects may, and probably do, co-exist. With all reserves and a full consciousness that in such matters hypothesis differs but little from speculation, Prof. Rucker states that he believes that the theory of induced rock magnetism, as the main cause of the disturbance, has the greater weight of evidence in its favor. Granting this, the nature of the material still remains to be solved. Is it virgin iron or pure magnetic, or merely a magnetic rock? Another phenomenon on which more light is desirable, is the permanent magnetization of magnetic rocks.

A paper by Lord Kelvin and Alex. Galt was read before Section A on "Preliminary experiments for Comparing the Discharge of a Leyden Jar through Different Branches of a Divided Channel." In these experiments the metallic part of the discharge channel was divided between two lines of conducting metal, each consisting in part of a test-wire, the other parts of the two lines being wires of different shape, material and neighborhood, of which the qualities in respect to facility of discharge through them are to be compared.

When the two wires were of the same material and length, but of different diameters, the testing elongation showed, as was to be expected, that the test-wire in the branch containing the thicker wire was more heated than the test wire in the other branch. With wires of different non-magnetic material—for example, copper and platinoid—of the same length, but of very different diameters, so as to have the same resistances, the testing elongations were very nearly equal.

In one series of experiments the tested conductors were two bare copper wires, each 0.16 cm. diameter, 9 meters long, and resistance 0.085 ohms, which is very small in comparison with 12 ohms in each of the platinum test wires. One of the copper wires was coiled in a uniform helix of 40 turns on a glass tube of 7 cm. diameter. The length of the helix was 35 cm., and the distance from centre to centre of neighboring turns therefore 7-8 cm. The middle of the other copper wire was hung by silk thread from the ceiling, and the two halves passed down through the air to the points of junction in the circuit. The elongation of the test-wire in this channel was more than twice as much as that of the test-wire in the channel of which the helix was part.

One hundred and seventy-one varnished pieces of straight, soft iron wire were placed within the glass tube, which was as many as it could take. This made the testing elongation ten times as great in the other channel.

The last comparison was between iron wire and platinoid wire conductors. The length of each was 502.5 cm. The diameter of the iron wire was 0.034 cm., and its resistance 6.83 ohms. The diameter of the platinoid wire was 0.58 cm., and its resistance 6.82 ohms. Each of these wires was supported by a silk thread from the ceiling, attached to its middle. Fourteen experiments were made, seven with the test-wires interchanged relatively to the branches in which they were placed for the first seven. The mean elongation of the platinoid channel was 0.183, and in the iron channel 0.124, while the energy used was nearly equal. The conclusion that the heating effect in the test-wire in series with the platinoid wire is nearly one and a half times as great as that of the test-wire in series with the iron, is certainly interesting, not only in itself, but in relation to Prof. Oliver Lodge's exceedingly interesting and instructive experiments on alternative paths for the discharge of leyden-jars, described in his book on "Lightning Conductors and Lightning Guards," which were not decisive in showing any general superiority of copper over iron of the same steady ohmic resistance, but even showed in some cases a seeming superiority of the iron for efficiency in the discharge of a leyden-jar.

Prof. Arthur Schuster read a paper in Section A on "A Possible Explanation of the Secular Variation of Terrestrial Magnetism," based upon the assumption that interplanetary space is a conductor of electricity. If there is an appreciable conductivity, the magnetic system of the earth will, owing to its rotation, induce currents which will react on the earth in a two-fold manner. There will be, in the first place, a mechanical effect tending to increase the length of the day, and, secondly, a magnetic effect tending to displace the magnetic axis. The conclusions of Prof. Schuster are, first, that the mechanical reactions on the earth of currents induced in space, assumed to be a conductor of electricity, by the rotation of its magnetic system, are insufficient to produce an appreciable lengthening of the day in historical times, unless the conductivity lies within certain narrow limits. The absence of any marked effect cannot, therefore, be brought forward as an argument against the conductivity of space; second, the magnetic reactions of the same current, taken in conjunction with the secular cooling of masses of iron inside the earth, tend to produce a displacement which in kind is the same as that actually observed in the secular variation. But whether quantitatively the variation can be explained in this way is doubtful, and can only be decided by further calculations.

Lord Kelvin, Magnus MacLean and Alexander Galt presented a paper on "Preliminary Experiments to Find if Subtraction of Water from Air Electrifies It," which seemed to show that such a process results in positive electrification, while the addition of moisture had apparently the opposite effect of negative electrification.

Association of Edison Illuminating Companies of the United States.

The convention of the Association of Edison Illminating Companies was held at the Hotel Vendome, Boston, on the 14th, 15th and 16th of August. This association is composed of the officers of lighting companies using the Edison system, who meet every year to discuss matters of mutual interest and strengthen the common bond which unites them all. The meeting this year was most successful from every point of view and its memory will long linger in the minds of those who were fortunate enough to be present.

TUESDAY, AUGUST 14.

First Session.

The following companies were admitted as new members of the association: Toronto Incandescent Light Company, Toronto, Ont.; Cleveland Electric Illuminating Company of Cleveland, O.; Atlantic City Electric Light Company of Camden, N. J.; Edison Illuminating Company of Cincinnati, O.; Edison Electric Illuminating Company of Atlanta, Ga.; United States Electric Light Company of Washington, D. C.; Union Electric Light Company of Seattle, Wash.

The first business of the meeting was the reading of a report by Mr. A. E. Kennelly, chairman of the committee on "Lightning Protection, Crosses With High Tension Wires, and Grounding the Neutral Wire on the Three Wire System." He gave a summary of the experience of Edison stations up to date from these dangers, with suggestions as to the means of preventing them. The report was accepted, and the subject was considered of sufficient importance to continue the committee. The reading of the committee's report was followed by an exhaustive discussion, in which Prof. Marks, Mr. Gilbert, Mr. Beggs and Mr. Edgar participated.

Prof. Marks' paper on "A Board of Control for Central Station Management Composed of the Heads of the Different Departments Making up the Organization," was then heard. This matter Prof. Marks has investigated in very great detail, fully elaborating all the important elements which enter into the composition of this question of business. The discussion which followed indicated the interest evinced by the representatives of other illuminating companies present, and also developed the fact that many differences of opinion existed, as regards not only the details, but the general principal upon which this Board of Control should be based.

The next in order was Mr. Hale's paper on "Boiler Testing." This paper was the result of a series of tests made at the new station of the Edison Electric Illuminating Company of Boston, and put before the convention some facts which have never previously been published in America. This paper was discussed at considerable length by the technical men present, who took a strong interest in the facts presented.

Second Session.

After the formal opening of the session, Mr. Van Vleck proceeded to read his paper on the "New York Illuminating Company's Switchboard." This paper started with a description of the switchboard in its earliest and most primitive forms, and ended by giving in contrast the well worked out plans of the regulating gallery at present being installed in the Duane street station of the Edison Electric Illuminating Company of New York. This paper prompted many questions from interested persons, especially in connection with the Edgewise system of electrical instruments developed by the author of the paper.

Following Mr. Van Vleck, Mr. Page read a paper on "Incandescent Lamps," which was presented to the Northwestern Electric Association and published in The Electrical World of August 4.

Mr. Barstow, of the Edison Illuminating Company of Brooklyn, then read a paper on the "Low Tension Arc Lighting System," describing the system used by the Brooklyn company in lighting the central portion of the city of Brooklyn from the low tension mains of the Edison Company in a manner never before attempted, this being the first instance in America where street lighting has been done from the low tension mains of the regular Edison underground system. This being the case, it had to be developed in all its details, including lamp posts, automatic clocks and kindred devices. The paper called forth many questions from interested members present. Mr. Barstow presented in this paper some data which seemed to show conclusively to the members present that this form of lighting would be a valuable adjunct to their central station business.

Mr. Pierce's paper followed on the "Methods of Electrical Distribution Adopted by the Edison Illuminating Company of Boston." This paper was presented as an introduction to the visit which the members were to make to the station in question the following day, and simply called the attention of the delegates to the various points of interest which they might desire to look at during their visit.

WEDNESDAY, AUGUST 15.

FIRST SESSION.

The second day's proceedings commenced with a "tally-ho" ride in the western suburbs of Boston, Chestnut Hill Reservoir, the Country Club, etc. Immediately upon the convening of the convention on Wednesday morning, the article on "Storage Batteries," by Mr. Bowker, of the New York Edison Company, to which all the members of the Association had looked forward with a great deal of interest, was read in Mr. Bowker's absence by Mr. Lieb, of the same company. Mr. Lieb presented, in conjunction with this paper, a paper of his own on the same matter, and nearly the whole session was taken up with an exhaustive description of the storage battery as applied to central stations. These papers developed much discussion, both for and against the practical value of the storage battery as an adjunct to central stations, and probably proved one of the most interesting and valuable discussions of the entire convention. A special committee was appointed by the president to consider and report upon this important subject.

SECOND SESSION.

The second session of the day was given up to matters pertaining to the relations with the General Electric Company, and included an address by Mr. C. A. Coffin, and an exhaustive paper by one of the General Electric Company's engineers, Mr. Emmet, on "The Relative Advantages of Alternating and Direct Current Apparatus for Central Station Work," which was discussed at great length and many interesting facts brought out in connection with the new "Monocyclic System" of the General Electric Company.

The committee on officers for the ensuing year brought in the following names in their report, which was unanimously adopted and nominees present declared duly elected:

President, C. L. Edgar, vice-president and general manager of the Edison Electric Illuminating Company, of Boston; vice-president, A. L. Smith, of Appleton, Wis.; secretary, W. S. Barstow, of Brooklyn, N. Y.; treasurer, J. W. Lieb, of New York. Executive Committee: John I. Beggs, chairman; C. P. Gilbert, Detroit, Mich.; E. R. Weeks, Kansas City, Mo.; W. D. Marks, Philadelphia, Pa.; G. R. Stetson, New Bedford, Mass.; C. L. Edgar, ex-officio, Boston.

At the urgent invitation of Mr. C. P. Gilbert, of the Detroit Edison Company, it was unanimously resolved that the next convention be held in that city on August 14, 1895. Votes of thanks were passed to the Boston Edison Illuminating Company, the New England Telegraph and Telephone Company, the Boston and Gloucester Steamboat Company, the West End Street Railway Company, and the Hotel Vendome, for courtesies extended, and the formal business of the convention concluded. The convention then adjourned.

THURSDAY, AUGUST 16.

On Thursday morning, following the adjournment, the party were conducted to the Albany street station of the West End Street Railway Company, where they had an opportunity of inspecting this magnificent plant. They afterwards visited the latest station of the Boston Edison Company on Atlantic avenue, where direct connected vertical engines and dynamos are employed. This is considered a model modern central station. A late addition is the storage battery auxiliary plant.

The plant generally and the elaborate switch-board arrangements were explained by the officers of the local company, and with especial reference to Mr. Pierce' paper. The visitors were then taken in charge by the representatives of the General Electric Company, who had arranged a most interesting exhibit at the Lynn works for their inspection. This visit was of unusual importance and interest as it was the first time that representatives of Edison operating companies had inspected, at least in their official and associated capacity, these extensive works.

On arriving at Lynn, lunch was served, after which Prof. Thomson, Mr. E. W. Rice, technical director; Lieut. S. Dana Greene, manager lighting department; W. C. Fish, manager Lynn factories; J. R. Lovejoy, manager supply department; I. F. Baker, mechanical department, and F. P. Cox, of the meter department, well known and zealous co-adjutors in the establishment and developement of the company, did the honors of the factory. Naturally, the construction and modes of testing of the various sizes (from 3 to 5000 amperes) and types of meters attracted much attention. A new meter of special efficiency for Edison circuits was shown, and also meters for arc-light circuits and for indicating the entire output of central stations, as well as portable and tropical meters.

Arc lamps of all kinds were on exhibition—long, short, plain, ornamental; lamps for series work and for alternating currents, as well as the Thomson '93 lamps for constant potential service.

The various processes and operations involved in the construction of dynamos, motors, meters and other apparatus were examined with much satisfaction. The extensive machine shops, winding rooms, testing rooms, (in large part operated by electric motors) the winding and insulation of armature coils, the tempering and setting of magnets for the meters, and the various labor-saving devices formed a most instructive and agreeable display.

Several large transformers for the Cataract Construction Company called for special notice. A 300kw. alternator of 125 cycles periodicity was in operation, smaller alternators and apparatus of lower frequency being also exhibited. Another exhibit in actual operation was a street railway track, equipped with two G. E. 800 motors and series parallel controllers, the whole of the wiring and connections being exposed to view.

Transformers of various kinds, lighting arresters, compensators, fuses, switches and samples of all sorts of supplies were also open to inspection.

An unexepected, but very agreeable addition to the pleasures of the afternoon was afforded in the shape of an exhibition by Professor Thomson of some of the phenomena of electricity under high pressure and high frequency. Professor Thomson in his usual charming and unaffected manner explained the peculiar action of currents of enormously high potential when used with exceedingly rapid alternations, many times that of the ordinary frequency. Under these conditions a person can have passed through his body without injury a quantity of current which, if a direcct current or at low frequency would almost certainly cause death. The apparatus used on this occasion raises by means of a transformer the usual alternating current of say 1,000 volts and of 15,000 alternations per minute, to a pressure of some 20,000 or 30,000 volts. This high potential then charges a condenser, and discharges over an air-gap across which an air-jet is blowing, producing high frequency currents. These currents are raised to a still higher pressure by a transformer (without iron) immersed in oil of high insulating properties, the final difference of potential between the terminals of the apparatus, as here shown, being estimated at about 1,000,000 volts.

Some interesting experiments were shown illustrating the high self-induction in a thick copper conductor subjected to currents of this nature. A thick wire of copper—apparently about No. 00 B & S—was connected directly across the terminals of the apparatus, in the form of a loop with only one turn. This was successively shunted by a thin piece of insulated wire further protected by card, by an incandescent lamp, by a fine piece of high resistance wire (which was heated to incandescence), and by the professor himself, (who, however, retained his normal placidity of demeanor); in all these cases the discharge followed what would ordinarily be considered the path of highest resistance.

That there was an appreciable current flowing was shown by the fact that Professor Thomson introduced himself in series with a 10 c.p. lamp, into the circuit, and it was evident that at least considerable current was passing. A discharge was passed along a thin wooden stick, which it was eventually allowed to consume, and another experiment with a water column (the sparks passing around instead of through the water) showed the fallacy of asuming that a water connection for a lightning ground must of necessity be satisfactory.

A number of other experiments were given showing the apparently erratic character of currents of this nature, in their various manifestations, simulating the nature of the lightning discharge.

The visitors expressed their appreciation of the interesting nature of this portion of the programme by frequent and hearty applause.

The party subsequently proceeded to the river works of the company, where they inspected the foundry connected with the factory, and saw the various processes connected with the preparation and casting of fields for generators, motors and other work of the same character. Thence coaches and drags conveyed the party for a drive from Lynn to Marblehead Neck, returning to Swampscott in time for dinner. On this portion of the exercises the presence of ladies graced the occasion, as was also the case at two or three theatre parties, this feature adding an additional charm to the proceedings.

The dinner at the Ocean House, Swampscott, was, as might be expected, of an excellent and artistic character. Mr. Coffin welcomed the guests in his graceful and hospitable manner, expressing his great pleasure in greeting the visitors and offering his assurance of harmonious and cordial relations in the future. Professor Thomson also made some pleasant remarks, referring in some degree to technical matters, and Lieut. S. Dana Greene congratuated the company and the representatives present on the agreeable relations of the various interests and the prospects for future business.

EXHIBITS.

The General Incandescent Arc Light Company of New York, showed a very fine exhibit of its latest "Bijou" and "Twin" Bergmann lamps, both in plain form and with artistic dead-black iron and polished brass ornamentation. The "Bijou" lamp is adapted for currents of small quantity, and is especially suited for interior illumination, and particularly for low-studded rooms. The "Twin" lamps are designed to enable street arc lighting to be provided for by means of the ordinary incandescent current, the two carbons being operated in series in one lamp, so that two pairs of carbons taking a current of four amperes each will give an illumination equivalent to one pair using eight amperes. For street lighting purposes it is evident that this system permits of a notable economy and convenience in wiring. The latest form of Bergmann short lamps has a chain-feed, the chain being wound upon a spring drum whose movements are controlled by a shunt-magnet. The carbon holders are adjustable to any size of carbon, and the mechanical parts are few and simple and characterized by the usual excellence in workmanship noticeable in "Bergmann" apparatus.

The Solar Arc Lamp Company, represented by Mr. H. W. Weller, had an interesting exhibit of different styles of arc lamps for constant potential circuits. This lamp has a rack feed with an escapement, its construction being very simple, a shunt-magnet controlling the release of the escapement mechanism. Simplicity and steadiness are prominent features claimed for this lamp.

Another interesting exhibit was a Weston ammeter of large capacity, for central station use. The instrument is of course much larger than the ordinary type, and the scale is disposed upon the edge instead of the face of the apparatus, the whole being mounted on a uitable stand. The instrument is made to read up to 7,000 amperes, and the indications can be distinguished at a distance of several feet.

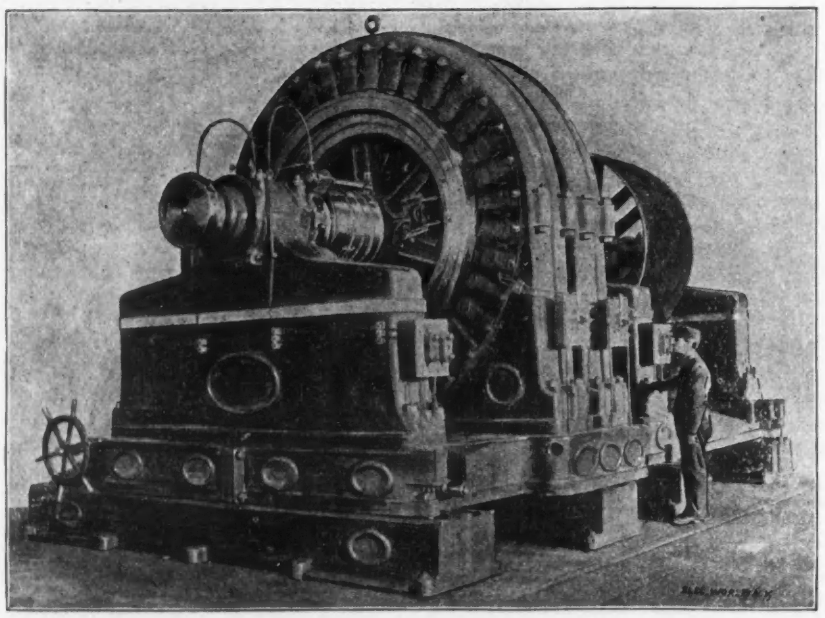


Fig. 9.—Alternating Current, 750 Kilowatt Diphase Multipolar Generator.

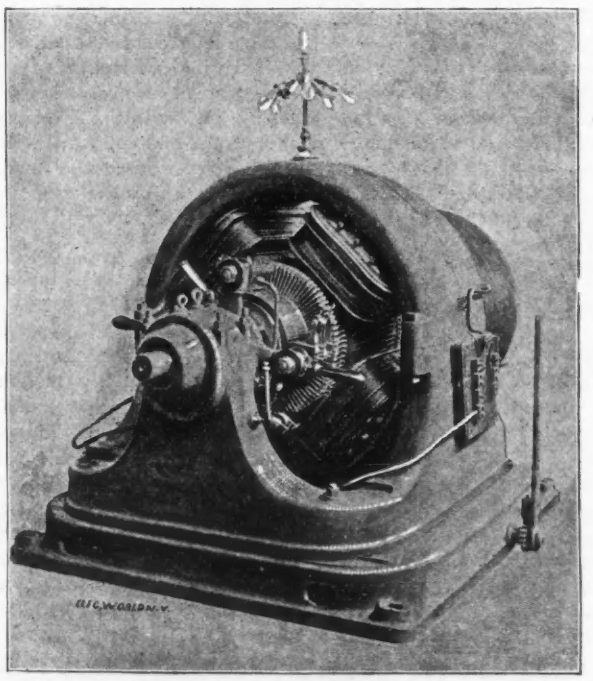


Fig. 10.—Continuous Current Self-Excited Compound-Wound Quadri-polar Generator.

Dynamo-Electric Machinery.—IV.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

13. Dynamo-electric machines may be conveniently divided into other classes, according to a variety of circumstances; for example, they may be divided according to the number of magnetic poles in the field frame, into

(a.) Bi-polar machines, or machines having only two magnetic poles.

Bi-polar machines may be sub-divided, according to the number of separate magnetic circuits passing through exciting coils, into single-circuit bi-polar, double-circuit bi-polar machines, and so on. Generally, however, modern bi-polar machines are not constructed with more than two magnetic circuits. Figs. 1, 2, 3 represent bi-polar machines. Of these, Fig. 1 possesses a single magnetic circuit, and Fig. 2 a double magnetic circuit.

(b.) Multipolar machines, or machines having more than two magnetic poles.

Fig. 10 represents a multipolar, diphase alternator of many poles. This machine was employed at the World's Columbian Exhibition.

14. Multipolar machines may be divided into the following subclasses:

Tri-polar, or those having three poles.
Quadri-polar, or those having four poles.
Sexti-polar, or those having six poles.
Octo-polar, or those having eight poles.
Deci-polar, or those having ten poles.
Duodeci-polar, or those having twelve poles, etc.

Tri-polar machines are seldom constructed. Quadri-polar machines are common. Fig. 11 shows a quadri-polar machine. This machine has four brushes and is compound wound. It is designed to supply 500 to 600 volts pressure at its brushes, and is surmounted by a group of six pilot lights in series.

Fig. 7 also represents a quadri-polar generator.

Fig. 12 shows a form of continuous current, self-exciting, compound-wound, sexti-polar machine, arranged for direct connection

to the main shaft of an engine. The machine is provided, as shown, with six collecting brushes.

Fig. 12 shows an alternating-current, self-exciting, octo-polar generator for arc circuits. Although this machine is an alternator, i. e., supplies alternating currents, it, nevertheless, supplies its field-magnet coils in series with continuous currents from the commutator, C, at one end of its shaft. The magnet forms an essential part of a short-circuiting device whereby the machine is automatically

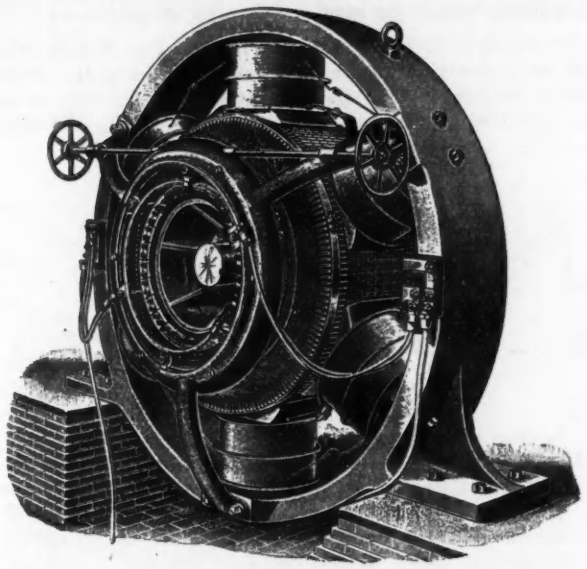


FIG. 11.—CONTINUOUS CURRENT, SELF-EXCITED GENERATOR.

short-circuited, on the external circuit becoming accidentally broken, when the pressure generated by the machine may become so great as to endanger the insulation of the armature.

Fig. 13 shows a deci-polar alternator, separately excited, and compensating. This machine is belt-driven, and it drives in turn a small dynamo, D, employed for exciting the ten field magnets. The commutator, shown at c, is provided for the purpose of automatically increasing the pressure at the brushes of the machine with the load, so as to compensate for drop of pressure in the line or armature.

As we have already observed, bi-polar machines may be subdivided into classes according to the number of magnetic circuits

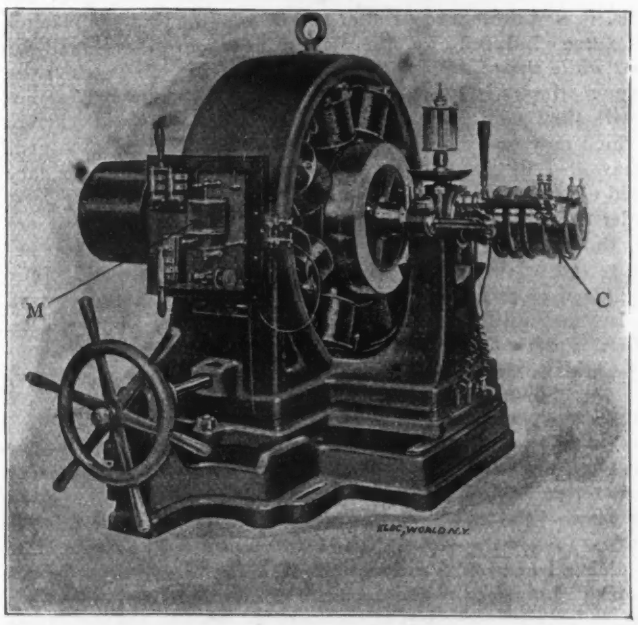


FIG. 12.—ALTERNATING CURRENT SELF-EXCITED OCTO-POLAR GENERATOR.

passing through their exciting coils. In general, multipolar machines may be similarly classified. But, as usually constructed, there are as many independent magnetic circuits as there are poles. Thus, a quadri-polar generator has usually four magnetic circuits, a sexti-polar six, and so on. In some cases, however, a double system of field magnets is provided, one on each side of the armature; in this case, the number of magnetic circuits may be double the number of poles.

15. In designing a continuous-current generator, the number of poles in the field is to a certain degree a matter of choice. In almost all cases, directly coupled, continuous-current dynamos are multipolar, while belt-driven dynamos are commonly bi-polar. Directly-coupled, continuous-current dynamos are usually multipolar machines, owing to the fact that in order to conform with engine construction, they have to be made with a comparatively slow speed of rotation, and since the E. M. F. generated depends upon the rate of cutting magnetic flux, if the speed of the conductor is decreased, the total amount of flux must be correspondingly increased. This necessitates a greater cross-section of iron in the field magnets, in order to carry the flux, and this large amount of iron is most conveniently and effectively disposed in multiple magnetic circuits. To a certain extent the number of poles is arbitrary, but usually, in the United States, the greater the output of a direct-driven generator, the greater the number of poles.

In alternators, however, the case is different. Here, in order to conform with a given system of distribution, the frequency of alternation in the current is fixed, and since the speed of revolution of the armature is determined within certain limits, by mechanical considerations, or by the speed of the driving engine, the number

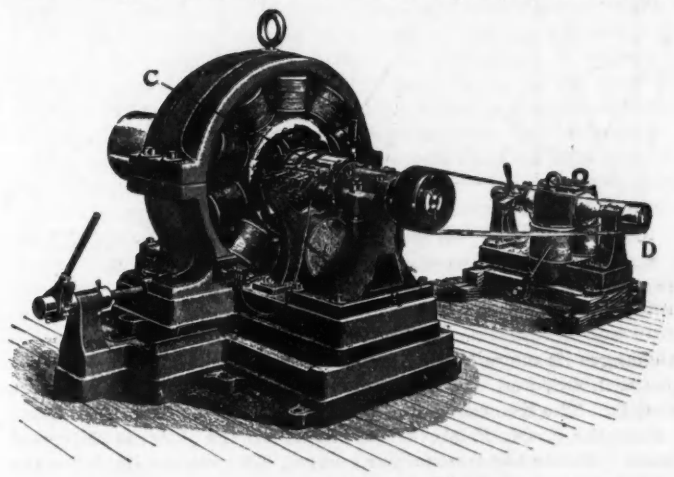


FIG. 13.—ALTERNATING CURRENT SEPARATELY EXCITED DECI-POLAR COMPENSATING GENERATOR.

of poles is not open to choice, but is fixed by the two preceding considerations. In any alternator, the number of alternations of E. M. F. induced per revolution in the coils of its revolving armature, is equal to the number of poles, consequently an alternator producing a frequency of 133′; that is a frequency of 133 complete periods or cycles per second delivers 266 alternations from each coil, and its armature must, therefore, pass 266 poles per second.

(To be Continued.)

Heroic Method of Preventing Fire Damp Disasters.

A Frenchman recently suggested preventing disasters due to the explosion of fire damp in coal mines by igniting the gases by electricity before the miners enter the shaft. If the gases are ignited continuously as fast as generated, and if the generation is not too rapid or too sudden, the method is prehaps not as unreasonable as might appear at first thought.

Niagara Falls Power Transmission.

The elaborate speculations, recently published in American journals, concerning the distance to which the Niagara Falls water-power can be transmitted economically, are claimed by the Lond. "Elec." to be a little premature; "there is a ludicrous resemblance to betting on the future jumping performances of an unhatched frog."

One of the Evil Effects of Competition.

"In spite of the fact that Buckingham possesses both electric and gas works, it is likely that in the coming winter the streets will be lighted by oil. This comes of having gas companies."—The London Electrical Review. The gas companies will probably say "this comes from having electric light companies."

Action of a Transformer with a Condenser in Parallel with the Secondary—II.

BY FREDERICK F. BEDELL AND ALBERT C. CREHORE.

EFFECTS OF A VARIATION IN THE CAPACITY OF THE CONDENSER WHEN THE ELECTROMOTIVE FORCE AT THE CONDENSER TERMINALS IS CONSTANT.

In Fig. 5 is reproduced Fig. 4, with lines added which show the variation in the quantities when the capacity of the condenser is changed. The same letters designate corresponding points in the different diagrams. As the capacity is varied, the condenser current changes its magnitude only. Its direction is always at right angles with OC, and its locus therefore upon the straight line labeled I_c. The line current, OD, does not change with the capacity, since the E. M. F. at the terminals of the line is supposed constant. Hence the transformer current, OT, has for its locus the line labeled I_t, parallel with I_c.

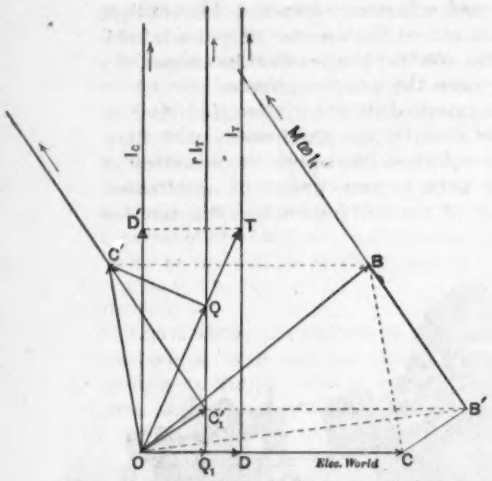


FIG. 5.—CONSTANT CONDENSER POTENTIAL DIAGRAM ILLUSTRATING CHANGE OF CAPACITY.

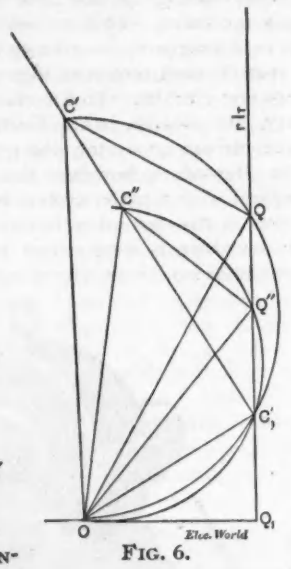


FIG. 6.

The E. M. F., OQ, for the transformer resistance is proportional to OT, and hence moves upon the line labeled rI_t. The angle C′OQ is always equal to arc tan $\frac{L_2\omega}{r}$, and is therefore constant for all positions of the triangle C′OQ. The angle at Q is always a right angle. Hence C′OQ is always similar to itself in any position. Under these circumstances, it follows that the locus of the point C′ is the straight line $C'C_1'$; and the point C_1' is a point upon Q_1Q, such that tan Q_1OC_1' equals $\frac{L_2\omega}{r}$.

This may be proved as follows: Fig. 6 represents that portion of Fig. 5 under consideration. The angle Q_1OC_1' equals arc tan $\frac{L_2\omega}{r}$. Draw $C_1'C'$ at right angles to OC_1', from C_1'. It will appear that this line is the locus of the vertex C′ of the triangle C′OQ as it moves with its right angle upon QQ_1, always being similar to itself. Take any point, Q, and from it draw QC′, perpendicular to OQ, until it meets $C_1'C'$ at C′. Likewise, take another point, Q″, and, in a similar manner, draw Q″C″. The triangles QOC′ and Q″OC″ are now similar, for, describe a semicircle, $C'QC_1'O$, about OC′ as diameter, and another, $C''Q''C_1'O$ about OC″ as diameter. Each of these arcs passes through the point C_1', because $OC_1'C'$ is a right angle. Now, the arcs C′Q and C″Q″ measure equal angles at the centres of their respective circles, since each subtends the inscribed angle $C'C_1'Q$. Hence the inscribed angle C′OQ is equal to the inscribed angle C″OQ″, as each is subtended in the respective circles by the arcs C′Q and C″Q″. Hence the triangles C′OQ and C″OQ″ are similar. But as these represent any two positions of the triangles, the proposition is proved.

Returning to the diagram (Fig. 5), it has been proved that OC′ lies upon the line $C_1'C'$. This is that part of the impressed E. M. F. which goes to overcome the transformer impedance. OC is that part which overcomes the impedance of the divided circuit. The resultant of OC and OC′ is OB, the transformer impressed E. M. F. Since OC is constant, OB varies along the line BB′, parallel with $C_1'C'$, as the condenser capacity changes. When the capacity is zero, D′ coincides with O, T′ with D, Q with Q_1, C′ with C_1', and B with B′.

This completes the diagram showing the effect of any change in the capacity, and, before altering the diagram to represent the case where the electromotive force, OB, is kept constant, we will draw the diagram showing the effect of a change in the resistance, R.

EFFECTS OF A VARIATION OF SECONDARY LOAD WHEN THE ELECTROMOTIVE FORCE OF THE CONDENSER IS CONSTANT.

We have reproduced in Fig. 7 the lines of Fig. 4, and added more to show the variation of the different quantities as the secondary resistance is changed. As the capacity is constant, OD′ remains fixed, but OD, the line current, varies inversely as R, and consequently D moves upon the line OC. The resultant of OD and OD′, viz., OT, therefore varies upon the line labeled I_t, which is parallel with OC. The E. M. F., OQ, to overcome the transformer resistance, being proportional to OT, lies upon the line rI_t. It may be proved, in a similar manner to the proof already given, that the locus of C′ is upon the straight line C_1' C′, which makes an angle arc tan $\frac{L_2\omega}{r}$ with the line rI_t. The locus of $M\omega I_1$ or of OB, is consequently a line BB′, parallel with $C'C_1'$, so that when the resistance is infinite, B coincides with B′, Q with Q′, T with D′, and C′ with C_1'.

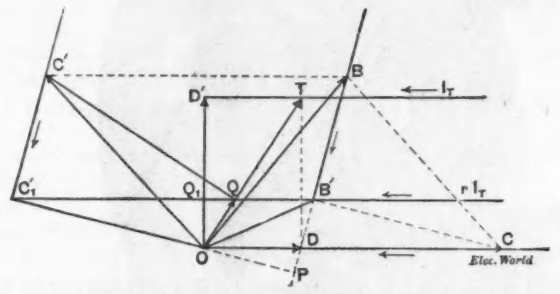


FIG. 7.—CONSTANT CONDENSER POTENTIAL DIAGRAM ILLUSTRATING CHANGE OF LINE RESISTANCE.

This completes the diagram, as far as a variation of the resistance alone affects it, from the standpoint of constant condenser potential.

Having obtained the diagrams for each case, viz., when the condenser capacity is varied, and when the secondary resistance is altered, from the consideration of constant potential at the condenser terminals, it is desirable to so alter these diagrams that the electromotive force induced in the transformer secondary will be constant, while the other quantities change. This occurs when the transformer primary is supplied with a constant current. The diagrams will then conform to the usual standard constant current form, which may easily be compared with others already obtained. They may also be changed so as to represent a constant primary impressed electromotive force.

In order to change the previous diagrams into those which are desired, the following general remarks in regard to the relation between directed or vecor quantities may prove of assistance, if they are not indeed essential to the method of solving the problem in hand. In the question before us, referring to Fig. 5, we have seen that, if OC represents the constant electromotive force at the condenser terminals, then OB, which represents the impressed electromotive force in the transformer, varies upon a straight line, BB′, as the condenser capacity is changed.

The question now is, how would OC, the condenser electromotive force, vary, if we select some value of the secondary electromotive force, as OB, to be kept constant? We know that for any given angle of phase difference between OC and OB, as COB, the relative magnitudes, that is the ratio, of the lines, must always remain the same, independent of absolute magnitude. This enables us to determine the character of the locus of OC when OB is taken as constant. To make the proposition general, refer to Fig. 8. Here we have any line MN along which a variable vector OB′ moves; and let OC represent some vector constant both in magnitude and in its direction with relation to OB′. Let OB be a certain position of the variable vector, which it is desired to maintain constant. To find the locus of the varying positions of OC, which, when variable, we call OC, so moving that the ratio of OC to OB is the same as that of OC to OB′ for any constant angle of phase difference, we may construct the locus by points as follows. OB′ is a particular value of the variable which makes the angle B′ OC_1 with the constant. Resolve OB′ to O3″ and OC_1 to OC_2 so that the angle

B′ OC_1=B″ OC_2. Then change the magnitudes of both OB″ and OC_2 proportionally, making OB″ take the value OB. Then OC_2 becomes CO_1 which gives the required point on the locus. The change from OC_2 to OC may be effected by drawing BC parallel with B″C_2. It will be found that the locus is a circle whose diam-

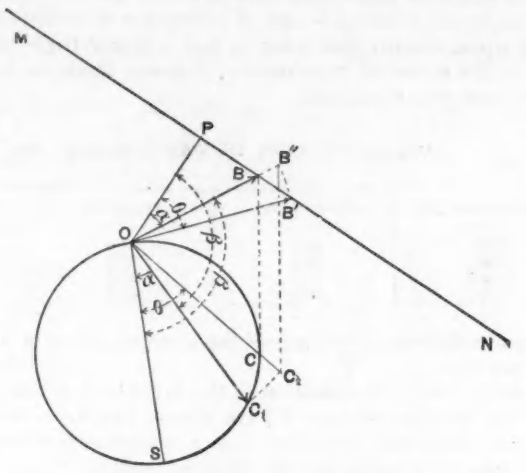


FIG. 8.—ILLUSTRATING GENERAL THEOREM.

eter OS makes the same angle with OB as OC_1 makes with the perpendicular OP upon MN.

These principles may be shown as follows: An equation of a straight line MN may be written,

$$OB' \cos \Theta = OP = \text{a constant.}$$

Now OC_1 is a constant vector making an angle β with OP. Hence,

$$OC_1 \cos \beta = m\ OP, \qquad (1)$$

where $OC_1 \cos \beta$ is the resolved part of OC_1 along OP and is consequently some multiple, m, of OP. By the preceding equations

$$OB' \cos \Theta = \frac{OC_1 \cos \beta}{m} = OP, \text{ a constant.}$$

In this equation OB′ and Θ are *variable* co-ordinates. But if it is desired to keep some value of OB′ a constant, say OB, and to make OC_1 variable, say OC; we then have $OB \cos \Theta = \frac{OC \cos \beta}{m}$, or, solving for OC, $OC = \frac{m\ OB \cos \Theta}{\cos \beta}$. Here $\frac{m\ OB}{\cos \beta}$ is a constant, equal to *OS* we will say. Then,

$$OC = OS \cos \Theta.$$

This is the equation of a circle, and shows that OC is a variable in a circle with diameter OS. The position of the diameter OS is determined by the relation above

$$m\ OB = OS \cos \beta. \qquad (2)$$

Dividing (1) by (2);

$$\frac{OC_1}{OS} = \frac{OP}{OB} = \cos \alpha.$$

Thus OS makes the same angle, a, with OC_1, as OB_1 makes with the perpendicular OP; this defines both the magnitude and direction of OS, the diameter of the circle. This general theorem may be stated as follows:

If a variable vector, OB′, has its origin at a point O, and terminus upon a straight line, MN, while OC_1 represents some constant vector; then another variable vector, moving upon a circle OCS (whose diameter, OS, makes the same angle, β, with a constant vector, OB, as the constant, OC_1, made with the perpendicular, OP, upon the straight line (MN) preserves the samerelative magnitude, or ratio, to its constant, OB, as the first variable, OB′, bears to its constant, OC, for the same angle of phase difference.

(To be Continued.)

An Incident of the Early Days of Telegraphy.

Yesterday was the fiftieth anniversary of the birthday of Prince Alfred, Duke of Edinburgh, and reigning Duke of Saxe-Coburg. During the early morning of August 6, 1844, the electric wire was first utilized on behalf of the Queen, to transmit from Windsor Castle to the Metropolis a Royal summons to the Cabinet Ministers then in office commanding them to repair to the Castle forthwith in view of the expected birth of a Prince or Princess. As a matter of fact, the despatch was forwarded by messenger to Slough Station, whence it passed over the wires of the Great Western Railway to Paddington Terminus. There arrangements had been made with Mr. Thomas Home, the sole licensee of the Cooke and Wheatstone telegraphic apparatus, who is still living, that on receipt of a message by wire, couched in certain prescribed terms, he should forthwith send to the respective addresses of the several Cabinet Ministers certain letters that had previously been intrusted to his keeping.

At the time when British Royalty thus accorded its patronage to telegraphy for the first time and in connection with a highly "interesting event," the instruments in use for the transmission of messages were Mr. Cooke's "double and single needle" telegraphs, and Professor Wheatstone's "electro magnetic printing," and "A. B. C." telegraphs. From 1842 to 1846, as we are informed, the charge levied was one shilling per telegram, irrespective of length, the messenger's fee being, of course, an "extra," bearing proportion to the distance to be covered before delivery. Messages were as correctly transmitted then as now, but by no means so rapidly. Practical telegraphy, in fact, was in its infancy when the Queen's second son made his debut upon the mundane stage. Its mechanical appliances were steadily being improved by the light of successive and assiduous experiments, but its popularity was not yet established upon a solid basis of public belief in its actual and potential capacities. Many people wondered at it, though few understood it. As for the utterly incredulous, their name was legion fifty years ago. The instruments at Paddington were "on view" for a shilling fee, which was daily paid by numbers of curious folk for the privilege of seeing the telegraph at work, and listening to a more or less lucid explanation of its marvellous powers. The early promoters of telegraphic enterprise transmitted hundreds of messages free of charge in order to convince the unbelieving that it was actually possible to annihilate time and space in communicating between one and another part of Great Britain. Even the ingenious contrivers of the instruments then in use had hardly grasped the full significance of the surprising force they were busily engaged in disciplining and regulating, or had dreamed of the extraordinary developments which it would undergo in the course of the Victorian era. In those days of the two-penny post, when a railroad was still something of a novelty, and "fast" steam-packets took three weeks to cross the Atlantic, who could have reasonably looked forward to a period, only distant by the length of a generation, when—not only in huge London, but in every considerable town of the United Kingdom—the six-penny telegram would be as familiar an object to all classes of the population as the daily newspaper, the lamp-post, or the omnibus?—London Daily Telegraph, August 7, 1894.

Sine Form of Curves of Alternating E. M. F.

To the Editor of The Electrical World:

Sir:—I do not concur in the statement made by the "London Electrician," that "the elaborate attempts which are being made by some of the American builders to give this property to their machines is utterly useless and a complete waste of time and energy."

In successful operation for the transmission and transformation of energy, the E. M. Fs. of the receiving or transforming machinery are always carefully balanced against the impressed or generator pressures. In some cases these E. M. Fs. are produced as exact duplicates of the impressed E. M. Fs. in shape and form, as is the case in the transformer, when the form of the E. M. F. curves will make practically no difference.

It has been found that the synchronous motor works best when it produces a motor E. M. F. that has the same form as the generator that supplies it with power. All induction motors work best when the motor E. M. F. and the impressed E. M. F. in the secondary have the same form. Rotary transformers must produce the same form of alternating E. M. Fs. at the rings that are produced by the generator. In the synchronous motor the counter E. M. F. is developed in a way that is largely independent of the form of the impressed E. M. Fs., and this is also the case with the rotary transformer. In these cases it is true that if the E. M. Fs. are not of the same form, currents will be established that will bring about a balance through induction, reactance and heating, resulting only in useless internal waste of energy that would not occur in the synchronous motor or rotary transformer which produced the same form of E. M. F. curves. Again, in the induction motor, a certain primary and secondary winding will, as Dr. Duncan points out, produce counter and impressed E. M. Fs. that have the same form in the motor's sec-

ondary with but one form of generator curve. If the generator E. M. F. curve varies on either side of this particular form, the impressed and counter E. M. Fs. of the secondary will differ in form, and, therefore, greatly in value from instant to instant. The result of this is much the same as for the synchronous motor.

One company of American builders has used the condenser practically for supplying the reactance currents to the primaries of their induction motors. A condenser can only do this work properly when the generator E. M. F. has the sine form.

A prominent American engineer declares that in long distance transmission of power the reactance currents which lessen the power factor and produce bad line and generator regulation can be kept out of the line and generator by the use of synchronous motors. Again for this same purpose the above company advocates the use of condensers. With the former method the synchronous motor and line pressures must possess the same form; with the latter the line pressure must have the sine form. Now it seems to me that all this indicates that there should be a reasonable approach to a standard form of E. M. F. curve on the part of makers of standard apparatus.

The form of curve for synchronous motors and rotary transformers can make but little difference so long as it coincides with that of the generator. The sine form for a generator is more easily approached as a motor E. M. F. in the secondary of an induction motor than the flat or thin-topped form. The condenser is at a great disadvantage except with the sine forms of E. M. F. For electric lighting only, from transformers, one form of generator E. M. F. can have but little advantage over another. Special apparatus not involving the use of condensers can be made to run equally well with almost any practically obtainable form of curve. Standard machinery of one make that is to be used for other purposes in addition to electric lighting will operate with machinery of another make only when strict attention has been given to the use of a standard form of E. M. F. Is there any form for a standard that presents more advantages and introduces fewer constructional difficulties or expenses than the sine form?

Ithaca, N. Y. HARRIS J. RYAN.

To the Editor of The Electrical World:

Sir:—In the mathematical treatment of alternating current phenomena the assumption is usually made that the wave is of sine shape, and this assumption is frequently justified by reference to the experimental tests of some pre-historic alternator, which just happened to give very nearly a sine wave, being in this regard very different from our modern ironclad alternators, which do not give anything like a sine wave.

Only very recently this theoretical objection has been overcome by defining the sine wave used in the calculation as the "equivalent sine wave," that is, a sine wave giving the same effective value and the same power as the true wave of the alternator, and therefore replacing it in practically all cases.

An enormous amount of theoretical discussion has been carried on to prove the superiority of the sine wave for motor work, for the efficiency of transformers, etc., and, I am sorry to say, mostly by theoretical men, who did not have any great chance to prove or disprove their theoretical conclusions by practical experience.

A number of claims of superiority made for the sine wave could, however, be easily refuted already by theoretical considerations. Take, for instance, the case of the efficiency of transformers. The hysteretic loss per cycle in the transformer exclusively depends upon the limiting values of magnetism, and will remain the same as long as these are the same. If the wave of E. M. F. is a sine wave, the magnetism will follow a sine wave also. If the wave of E. M. F. differs from the sine shape, we can consider it as a fundamental sine wave with higher harmonics superimposed thereon, and then the wave of magnetism will also be a distorted wave, consisting of a fundamental sine wave superimposed by sine waves of triple, quintuple, etc., frequency. It is obvious now that if the triple harmonic wave of magnetism is superimposed upon the fundamental wave in such a way as not to increase its maximum value, the core loss will not be increased, but the amount of energy transformed is increased by the energy of the triple harmonic, for, as known, the energy of an alternate current wave is equal to the sum of the energies of the individual harmonics, since:

$$\int_0^{2\pi} \left\{ \Sigma\ d_n \sin(n\phi - \tilde{\omega}_n) \right\}^2 d\phi = \tfrac{1}{2}\ \Sigma n d_n^2$$

In this case, the wave of magnetism will be flat-topped, and thus the wave of E. M. F. peaked, hence of a shape like that of the modern ironclad alternator. That means the sine wave of E. M. F. is not the most efficient for transformation, but the peaked form of wave as given by the modern ironclad alternators gives in transformation a lesser core loss, by from 9 to 10 per cent. Just here I have no more recent tests at hand and so am giving the experimental results of some tests carried out at the time when the introduction of the ironclad design of alternators was ventilated, and for this purpose careful tests made to find whether there is any difference in the action of transformers, between these machines and the old smooth core machines.

HYSTERETIC LOSS IN WATTS (August, 1891).

Transformer No.	Sine Wave.	Ironclad.	Difference.
35992	42.3	38.6	9.8%
36067	41.1	37.8	8.95%
36668	36.8	33.9	8.7%
35799	36.6	33.7	8.7%

Average difference in favor of the distorted wave of the ironclad: 9.03 per cent.

Coming now to the question of the influence of the wave shape upon the action of motors, I have always had some suspicion that the wave shape has been abused as a scapegoat for explaining the inefficiency of a motor due to improper design.

With the extensive introduction of induction motors in this country, it became necessary to see whether there is any difference in the action of a motor when operated by sine waves and by the waves of ironclad alternators. Tests, however, carried out by running one and the same three-phase induction motor—a properly designed motor, indeed—first from an alternator giving a sine wave, then from an ironclad alternator giving a sharp pointed wave, and lastly with a flat-topped wave given by reversing the current of a continuous current dynamo by a number of two-part commutators, showed no difference in the action of the motor with regard to output, efficiency, starting torque, etc., except that in a few cases there seemed to be a slight advantage in efficiency in favor of the distorted wave of the ironclad alternator, probably due to the lesser hysteretic loss caused by such a wave. This difference, however, was too small to be definitely proved. Since that time induction motors and synchronous motors are designed and built without further reference to the wave shape, and some thousands of kilowatts of motors in successful operation proved the correctness of this statement.

The question of resonance with higher harmonics, that is of the dangerous rise of potential, which may occur in long distance transmission by the combined action of capacity and self-induction, can easily be disposed of by the fact that a transmission line which is liable to give dangerous rise of voltage by resonance with the triple or quintuple harmonic is not fit for use with the fundamental wave either.

These considerations, which, as before said, I found fully proved by practical experience, have completely convinced me that the superiority claimed for the sine wave is a mere superstition without actual foundation, and that in ordinary distribution work the sine wave is rather at a disadvantage in transformers, so that I have given up any endeavor to build alternators with sine waves.

Thus I can only fully indorse the view taken by the "London Electrician" in its criticism of sine wave alternators, so far as the criticism is general.

To the particular machine, however, which started the discussion, this criticism does not apply, but in this machine considerations entirely outside of the question of transformer efficiency or motor work have induced me to choose a design giving a practically perfect sine wave; conditions, however, entirely specific to the central station, for which this machine is intended, and, therefore, of no further interest for the present discussion, except in so far as they prove that even with an ironclad construction of alternator—which is indispensable in modern times—practically perfect sine waves can be produced. CHAS. P. STEINMETZ.

Schenectady, N. Y.

The results of some tests just made of the core loss of a 200 kw. transformer very plainly bear out my statement. With the generator giving very closely a sine wave, the observed core loss was 3,300 watts, while with the wave of an iron clad alternator, at the same voltage and same frequency, the core loss was found to be only 2,860 watts, giving an advantage of over 13 per cent. in favor of the distorted wave of the ironclad. I may add that in this case the distortion of the wave was larger than usual, the ironclad being speeded down to the low frequency of 25 cycles. C. P. S.

Symbols for Physical Quantities and Abbreviations for Units.

Recommended by the Committee on Notation of the Chamber of Delegates of the International Electrical Congress of 1893.

With the names added in italics of the practical magnetic units provisionally adopted by the American Institute of Electrical Engineers.

Corrected by M. Hospitalier.

Physical Quantities.	Symbols.	Defining Equations.	Dimensions of the Physical Quantities.	Names of the C. G. S. Units.	Abbreviations of the Names of the C. G. S. Units.	Practical Units.	Abbreviations of the Practical Units.
Fundamental.							
Length	L, l	.....	L	Centimetre.	cm	Metre.	m
Mass	M	.....	M	Mass of one gramme.	g	Mass of a kilogramme.	kg
Time†	T, t	.....	T	Second.	s	Minute ; hour.	m ; h
Geometric.							
Surface	S, s	$S = L.L$	L^2	Square centimetre.	cm^2	Square metre.	m^2
Volume	V	$V = L.L.L$	L^3	Cubic centimetre.	cm^3	Cubic metre.	m^3
Angle	α, β	$\alpha = \frac{\text{arc}}{\text{radius}}$	A number.	Radian.	.....	Degree ; minute ; second ; grade.	
Mechanical.							
Velocity	v	$v = \frac{L}{T}$	LT^{-1}	Centimetre per second.	cm : s	Metre per second.	m : s
Angular Velocity	ω	$\omega = \frac{v}{L}$	T^{-1}	Radian per second.	.....	Revolutions (turns) per minute.	t : m
Acceleration	a	$a = \frac{v}{T}$	LT^{-2}	Centimetre per second per second.	$cm : s^2$	Metre per second per second.	$m : s^2$
Force	F, f	$F = Ma$	LMT^{-2}	Dyne.	dyne	Gramme ; kilogramme.	g ; kg
Work	W	$W = FL$	L^2MT^{-2}	Erg.	erg	Kilogrammetre.	kgm
Power	P	$P = \frac{W}{T}$	L^2MT^{-3}	Erg per second.	erg : s	Kilogrammetre per second.	kgm : s
Pressure	p	$p = \frac{F}{S}$	$L^{-1}MT^{-2}$	Dyne per square centimetre.	$dyne : cm^2$	Kilogram per square centimetre.	$kg : cm^2$
Moment of Inertia	K	$K = ML^2$	L^2M	Gramme-mass-centimetre-squared.	$g\text{-}cm^2$		
Magnetic.							
Strength of Pole	m	$F = \frac{m^2}{L^2}$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-1}$				
Magnetic Moment	$\mathfrak{M}$	$\mathfrak{M} = ml$	$L^{\frac{5}{2}}M^{\frac{1}{2}}T^{-1}$				
Intensity of Magnetization	$\mathfrak{I}$	$\mathfrak{I} = \frac{\mathfrak{M}}{V}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$				
Field Intensity	$\mathfrak{H}$	$\mathfrak{H} = \frac{F}{m}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	*Gauss.*	.....	*Gauss.*	
Flux of (Magnetic) Force	Φ	$\Phi = \mathfrak{H}S$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-1}$	*Weber.*	.....	*Weber.*	
Magnetic Induction	$\mathfrak{B}$	$\mathfrak{B} = \mu\mathfrak{H}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	*Gauss.*	.....	*Gauss.*	
Magnetizing Force‡	$\mathfrak{H}$	$\mathfrak{H} = \frac{4\pi NI}{L}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	*Gauss.*	.....	*Gauss.*	
Magnetomotive Force	$\mathfrak{F}$	$\mathfrak{F} = 4\pi NI$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	*Gilbert.*	.....	*Gilbert*; 1 *Gilbert* = 0.7958 ampère-turns (a-t).	
Reluctance (Magnetic Resistance)	$\mathfrak{R}$	$\mathfrak{R} = \nu\frac{L}{S}$	L^{-1}	*Oersted.*	.....	*Oersted.*	
(Magnetic) Permeability	μ	$\mu = \frac{\mathfrak{B}}{\mathfrak{H}}$	A number.				
(Magnetic) Susceptibility	κ	$\kappa = \frac{\mathfrak{I}}{\mathfrak{H}}$	A number.				
Reluctivity (Specific Magnetic Resistance)	ν	$\nu = \frac{1}{\mu}$	A number.				
Electromagnetic.							
Resistance	R, r	$R = \frac{E}{I}$	LT^{-1}	.....	.....	Ohm.	ohm
Electromotive Force	E, e	$E = RI$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-2}$	.....	.....	Volt.	v
Difference of Potential	U, u	$U = RI$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-2}$	.....	.....	Volt.	v
Intensity of Current	I, i	$I = \frac{E}{R}$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	.....	.....	Ampère.	a
Quantity of Electricity	Q, q	$Q = IT$	$L^{\frac{1}{2}}M^{\frac{1}{2}}$	.....	.....	Coulomb ; ampère-hour.	c ; a-h
Capacity	C, c	$C = \frac{Q}{E}$	$L^{-1}T^2$	.....	.....	Farad.	F
Electric Energy	W	$W = EIT$	L^2MT^{-2}	.....	.....	Joule ; watt-hour.	J ; w-h
Electric Power	P	$P = EI$	L^2MT^{-3}	.....	.....	Watt ; kilowatt.	W
Resistivity (Specific Resistance)	ρ	$\rho = \frac{RS}{L}$	L^3T^{-1}	.....	.....	Ohm-centimetre.	ohm-cm
Conductance	G, g	$G = \frac{1}{R}$	$L^{-1}T$	.....	.....	Mho.	mho
Conductivity (Specific Conductance)	γ	$\gamma = \frac{1}{\rho}$	$L^{-3}T$				
Coefficient of Induction (Inductance)	L, l	$L = \frac{\Phi}{I}$	L	.....	.....	Henry.	H

† The International Bureau of Weights and Measures has established an important distinction in the notation of time, according as it refers to the *epoch* (date of time or day) or the *duration* of a phenomenon. In the former case the reference letters are used as indices, and in the latter they are on the same line with the numbers; for instance, an experiment began at $2^h\ 15^m\ 46^s$, lasted 2h. 15m. 46s., and ended at $4^h\ 31^m\ 32^s$. This method is to be recommended.

‡ N is the number of windings, and L the length of the solenoid generating the magnetizing force.

NOTE.—The symbols for magnetic units are known to printers as *French script*, and may be so designated on MSS. The style here used, recommended by M. Hospitalier, is that of the foundry of Damon & Peets, 44 Beekman Street, New York.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Vacuum Tube Experiments.—Sir David Salomons, in the London "Elec.," July 27, describes as a remarkable result the following experiment: A tube was fitted with two Hertz grids, placed midway in its length and crossed, under which conditions the current should not traverse the tube end to end; the result of a test was that under no conditions could the tube be made to show the faintest sign of light. In the issue of August 3, Mr. Pyke suggests that perhaps the connections for continuity were not traced out, and that it is therefore not right to assume that no light was produced by the passage of a current through a vacuum; he asks what proof existed that there was actually a current flowing.

Electrostatic Hysteresis.—Some further experiments by Mr. Arno are mentioned briefly in the Lond. "Elec.," August 3; the energy, dissipated by a dielectric suspended in a rotating electrostatic field, is equal to a constant multiplied by the electrostatic induction, raised to a power equal to 1.6 for low induction and 1.9 for high induction.

Rotation in Vacuum.—An experiment by Mr. Arno, in which a small wheel with metallic vanes is made to rotate by electrostatic fields, is described briefly in "L'Elec.," August 4.

Mechanical Effect of Electric Waves.—The Lond. "Elec.," July 27, abstracts briefly a paper by Mr. Lebedew from the "Wied. Ann.," No. 8, describing experiments to show the mechanical effects of electric waves.

Diselectrification of Bodies by Light.—In the Lond. "Elec.," July 27, Dr. Lodge gives an abstract, including illustrations, of a number of papers by Messrs. Elster & Geitel, published in the "Wied. Ann."

Analogy Between Electro Magnets and Induction in Looped Circuits.—In an article of some length in the "Elek. Zeit.," July 26, Mr. Christiani points out that there is a useful analogy between the induction of double circuits and electro magnets.

Determining the Form of Periodic Curves.—A further description of the electro-chemical method of Mr. Janet is given in "L'Ind. Elec.," July 25, and "L'Elec.," July 28 and August 4.

Electricity of Drops.—A paper by Prof. J. J. Thomson, in the "Phil. Mag." for April, is abstracted in the Lond. "Elec. Rev.," August 3.

Entropy.—An article giving some analogies is contained in the Lond. "Elec.," August 3.

MAGNETISM.

Effect of Magnetisation on Volume.—A Royal society paper by Mr. Bidwell on the effect of magnetisation on the dimensions and volume of iron rings, is reprinted, with the illustrations, in the Lond. "Elec. Rev.," August 3; results are given in tables and curves.

Magnetic Properties of Alloys.—Some results from a recent paper of Mr. Osmond, read before the French Academy of Sciences, are published in the Lond. "Elec. Rev.," July 27, the alloys tested containing various percentages of iron, with carbon, silicon and nickel, chiefly of the latter.

Hollow and Cylindrical Iron Cores.—The article by Mr. Du Bois, mentioned in the Digest, June 2, is abstracted briefly in the Lond. "Elec.," August 3.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Photometric Units and Quantities.—In "L'Ind. Elec.," July 25, Mr. Hospitalier publishes a summary of the systems suggested by Prof. Blondel and published in the Digest August 11, adding the suggestion that the last quantity in the table, called "quantity of light," be called by the name "lighting" (eclairage), this being the quantity in terms of which commercial lighting can be measured. He does not approve of the symbols suggested by Blondel, as some of them are the same as those used for other physical quantities; he recommends the discussion and adoption of such a system; he intends to adopt it in that journal. This system, he states, is a good development of the general ideas which he (Hospitalier) proposed in 1889.

Transportable Galvanometer.—A new form made by the firm of Hartmann & Braun, is illustrated in the "Elek. Zeit.," July 26; the telescope and scale are secured at the end by an arm, which is pivoted on the galvanometer itself; it is astatic and the needle has a long suspension.

Capillary Electrometer.—A Physical Society paper by Mr. Bouty, on the capacity of such instruments, is abstracted in "L'Ind. Elec.," July 25.

TRANSFORMERS.

Current Rushes in Transformers.—Mr. Hay's article (see Digest, August 4), is continued in the Lond. "Elec.," July 27; he discusses the curves obtained experimentally; in regard to the connection between the current rush and the phase of the current at the instant of switching off, he comes to the following conclusions: "(1.) If the switch is opened when the current is diminishing numerically, then the exact point on the current-wave at which the circuit is broken is immaterial, since the iron always returns to the same state. (2.) If the switch is opened when the current is increasing numerically, then a very slight difference in the instant of switching off may produce a considerable variation in the 'rush.' (3.) If the switch is closed at the instant when the e. m. f. has a small value, there will always be an abnormal current-rush, quite independently of the magnetic state of the iron." In the issue of August 3 he discusses the effect on the rush by varying the normal maximum of magnetic induction to which the iron is worked, illustrating it with several diagrams.

Transformer System.—In a commmunication to the Lond. "Elec. Rev.," July 27, Mr. Alfred Thompson discusses the Whitcher system and gives some results obtained with the Lowrie system. The Lowrie "intraposed automatic system" of electrical distribution is described at some length, with illustrations, in the Lond. "Elec. Eng.," July 27.

ARC AND INCANDESCENT LIGHTS.

Economic Age of Incandescent Lamps.—In an article by Mr. Gasnier, in "L'Ind. Elec.," July 25, he applies to the results recently published by him (see Digest, June 9) the method suggested by Mr. O'Keenan for determining the most economical age at which incandescent lamps should be run; (the system is explained in an article in The Electrical World, December 24, 1892, page 404, and March 18, 1893, page 204). He assumes 20 cents for the cost of a kilowatt-hour and 30 cents for the price of a lamp. Six sets of curves are given, three for 10 c. p. lamps of 2.46, 2.84 and 3.4 watts per candle, respectively, and three for 16 c. p. lamps of 2.23, 2.51 and 3.2 watts per candle, respectively. He states that it would require an experienced eye to tell from simple inspection a difference of as much as 20 per cent. in the candle-power of lamps, and he therefore considers that lamps may be run up to a loss of 25 per cent. in candle-power. In the high efficiency lamps the best life as obtained from the O'Keenan curves is greater than that at which they lose 25 per cent., showing that, notwithstanding this loss in candle-power, it is still economical to use the lamp; with lamps having an efficiency of 2.84 and 2.51 watts per candle, the life obtained in these two ways is about the same, while for low efficiency lamps the life obtained from the allowable fall of candle-power is considerably greater than that obtained from the O'Keenan curves, and it will therefore be of advantage in this case to use the lamps longer than the point obtained from these curves. To show the advantage of forcing lamps he finds that the minimum price of a candle-hour for a 3.2 watt lamp is about 15 per cent. greater than that of a 2.2 watt lamp. He concludes that when lamps are forced below 2.6 watts per candle, it will be of advantage to the user to keep the lamps until they lose 25 per cent. of their candle-power, lamps of 16 c. p. originally being then still economical as 10 c. p. lamps; three watt lamps and over can also be used economically beyond the limit in the O'Keenan curves. It is not possible to fix once for all the most economical age for any make of lamps, there being such a variation among the lamps; the only guide is the variation in the candle-power; his rule, therefore, is to continue to use the lamps a little beyond the point corresponding to the admissible fall in candle-power.

Incandescent Lamps.—Some of the figures from Mr. Larnaude's article mentioned in the Digest July 28 and August 11, are given in the Lond. "Elec. Eng.," July 27.

Arc Lamps.—The serial of Mr. Kennedy is continued in the Lond. "Elec. Rev.," August 3. He discusses electromagnetic devices.

ELECTRIC RAILWAYS.

Locomotive vs. Motor Cars.—According to the English journals of July 27, the City & South London Underground Railway is about to make experiments with a view of substituting motors on the cars themselves in place of the present separate locomotive, thereby also enabling an additional car to be used in every train; as the running expenses have now become stationary at 12.4 cents per train mile (we believe a train comprises one locomotive and three short cars), it is thought that this change offers the best means for increasing the income.

Kiew Railway.—A description of this railway, including a number of illustrations, is given in "L'Elec.," July 28 and August 4; a number of the devices differ from those used in this country.

Rapid Transit in Cities—An editorial in the Lond. "Elec. Rev.," July 27, claims that the trolley system cannot be introduced in cities with crooked, narrow streets, and that the only suitable methods are

underground or elevated railways, using electrical traction; it claims that no system in which rails are not used can ever fulfill the necessary conditions, one of the reasons being that nothing but an iron way can stand the weight of vehicles carrying their own motive power.

Railway Circuits.—In "L'Elec.," July 21, Mr. Dieudonne summarizes the various methods of bonding rails, but giving apparently nothing new to Americans.

CENTRAL STATIONS, PLANTS. SYSTEMS AND APPLIANCES.

Cost of Electrical Energy.—The Lond. "Elec.," July 27 and August 3, publishes in full the communicated remarks on Mr. Crompton's recent paper on this subject and the author's written reply; the remarks of Mr. Sharp include a design for a flywheel, equivalent, under certain circumstances, to an engine of 400 h. p. for use in connection wth railway power stations. The subject is also discussed editorially. The device of Mr. Sharp is discussed unfavorably in an editorial, on the ground that no known material will stand the strain; in a communication in the issue of August 3, Mr. Sharp makes what appears to be a satisfactory reply.

Large Three-phase Plant.—According to the Lond. "Elec. Eng.," July 27, what is said to be the largest station which has been designed for this system, has been carried out by the firm of Siemens & Halske, of Chemnitz; there are three engines and dynamos, each of about 200 h. p., the voltage being about 2,000; there has been a large demand for motive power, amounting to about one-third of the capacity; the working is satisfactory, especially in case of parallel running.

Polyphase Systems.—The leading editorial in the Lond. "Elec. Rev.," August 3, advocates polyphase systems, but contains nothing new.

Alternating Current Distribution.—An editorial in the Lond. "Elec. Rev.," July 27, chiefly of local interest, discusses the arrangement of the leads, stating that to put both in the same pipe or to run them concentrically, has proved to be very satisfactory, notwithstanding objections to the contrary by advocates of the continuous current system.

Manchester.—A description of the new electric lighting station by Dr. John Hopkinson is given in the Lond. "Elec. Eng.," August 3.

Budapest.—A description, with three full-page illustrations of the connections, is published in "L'Ind. Elec." July 25.

Gas Engine.—According to "L'Ind. Elec.," July 25, the Charon engine recently tested, showed a consumption of 37.9 cu. ft. of gas per horse-power hour with an "organic" efficiency of 52.6 per cent. at one-third of its output; at one-half output the values were 26.4 and 63.1 per cent., and at full charge 17.1 and 89.2 per cent.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Induction Telegraphy.—A Royal Society paper by Mr. Stevenson, is published apparently in full in the Lond "Elec. Eng'," July 27, and in abstract in the Lond "Elec.," August 3; he describes a recent trial made on a large scale with his system in which communication from a lighthouse on an island to the mainland was established; two coils, consisting each of nine turns, 200 yards in diameter, of No. 8 iron wire, were used, one on the mainland and one on the island, the distance between the centres being 850 yards, the current being one ampere; 100 dry cells gave good results, the reading in the secondary being made by two telephones; with fifteen cells the messages could still be sent. He describes some experiments made to test the relative merits of the parallel wire and the coil systems, and concludes "that it has been admitted to be shown that the coil system is not only theoretically but practically the best."

Disturbances in Telephones Due to Railway Circuits.—An article by Messrs. Meyer & Muetzel is contained in the "Elek. Zeit.," July 26; it is supplementary to their article abstracted in the Digest June 9, and relates to subsequent experiments made with telephones of lower resistance, such as those without induction coils for short distances; they found that the noises produced by the railway currents were then very much greater and could be heard when no sounds could be heard with the high resistance instruments; they therefore recommend the use of high resistance instruments in such cases; they conclude that induction is the chief cause of the trouble, that due to the earth currents being of much less importance.

Submarine Telegraphy to the Far East.—The Lond. "Elec.," July 27, publishes a supplement containing the speeches made at the recent silver jubilee (twenty-fifth anniversary) of submarine telegraphy to the far east; it contains an article on the summary of the progress of submarine telegraphy; the subject is discussed editorially. The Lond. "Elec. Rev.," July 27, also contains an article on this subject.

Two New Atlantic Cables.—An article on this subject is contained in the Lond. "Elec. Rev.," July 27. It is stated that including the cable at present being laid by the Anglo-American Company, the number of cables crossing the northern Atlantic is fifteen, of which three have been definitely abandoned and eleven are in a more or less perfect state of repair.

New Caledodian Cable.—Mr. Reynier's article, mentioned in the Digest, July 28, is abstracted in the Lond. "Elec. Rev.," July 27,.

ELECTRO-CHEMISTRY.

Cupron Battery.—The "Elek. Zeit.," July 26, mentions an improvement in the Lalande copper-oxide-zinc alkali cell, recently exhibited in Germany and made by a German firm under the above name; the principal improvement seems to be the construction of the copper-oxide plates, the process, however, being kept a secret; it appears that these improved plates may be regenerated, that is, re-oxidised, by merely exposing them to the air; in the older forms the regeneration of the copper-oxide plates is said to have been a somewhat difficult matter.

Chloride of Lead Accumulator.—The Lond. "Elec. Rev.," July 27, contains an article by Mr. Andreoli, in which he claims to be the first inventor; he cites a number of other patents, showing that portions of the process are old; he believes it to be the best accumulator.

Alloys in Voltaic Circuits.—Attention is called in the Lond. "Elec. Rev.," August 3, to a paper by Mr. Laurie in the "Phil. Mag.," describing researches with a large number of alloys.

Impurities of Aluminum.—An Academy paper by Mr. Moissan, is published in "L'Elec.," July 21.

MISCELLANEOUS.

Electric Welding.—A paper by Mr. Dobson is reprinted at some length in the Lond. "Elec. Rev.," August 3, and somewhat more fully in the Lond. "Elec. Eng.," August 3. His experience is based on nearly three years' working with the Thomson system; he found that the power required had been very much understated, a two-inch iron bar having been thought to require 30 h. p. to weld, while he found it to require as much as 80; a table is given containing the electrical power, duration and the indicated power for a number of welds; a two-inch wrought iron bar required about 250 h. p. for about 250 seconds, a one-inch bar about 42 h. p. for 50 seconds, a one-inch Bessemer steel shaft slightly more than this, a one-half-inch Bessemer steel bar about 34 h. p. for about 30 seconds. Another table gives the results of experiments for detetrmining the strength of electrical and hand welds, which were tested by bending them; it was found important to anneal the bar for several inches on both sides of the welds; with smaller sizes he experienced little difficulty in bending the welded bars, while cold, around their diameter; some tensile strength tests showed an average tensile strength of welded bars equal to between 92 and 100 per cent. He states that the process is a thoroughly practical one; he found that there was not one out of 500 welds that turned out a failure or was even defective; his experiments showed better results than those obtained at the United States Arsenal; aside from the cost of wages, which is considerably less, the cost of power, royalty and depreciation bring the total cost considerably over the cost of the ordinary smith's weld; he states that in straightforward welds the total cost will be between 10 and 15 per cent. more than for the smith's, while for difficult work and delicate operations, the cost will be about one-third that of smith's work; the loss of iron is only about one-twentieth; the real difficulty is not so much a question of economy as a method of securing an absolutely reliable result.

Bernardo Welding System.—In an article by Mr. Richter in the Elek. Zeit.," July 26, he points out the objections to welding by means of the arc and suggests certain improvements. He claims that this system adapts itself specially to those cases for which the Thomson and hydro-electric methods require too great an amount of energy; among the objections are that the fibrous structure is converted into a crystalline one, that the metal becomes hard and that some of the valuable properties of iron and steel are destroyed on being heated to such a high degree; he gives tables of the results of tests with a large number of welds, showing the tensile strength and the elongation, in some the iron was hammered and in others it was annealed; he states that there is no reason to believe that the hardness is due to the introduction of carbon from the arc into the iron, because the original softness, though not the original tensile strength, can be restored again by annealing; the process is specially adapted for such metals as copper, lead, tin and the noble metals, another objection lies in the use of an accumulator battery in parallel with the dynamo, which involves not only greater cost but greater loss of energy; he therefore suggest using a dead resistance in place of the battery, which can be cut out of circuit automatically while the arc is used, by a simple apparatus; if the dynamo can stand having the circuit opened completely, this reasistance will not be necessary; he claims that the loss in this resistance is less than that in the batteries; to reduce the momentary starting current he introduces a choking coil; he recommends connecting the engine with the dynamo by means of an elastic belt; a larger dynamo will be required when no accumulators are used.

Magnetic Chain Towing.—"La Lum. Elec.," July 14, publishes at considerable length the first part of a report by Mr. Fontaine on the magnetic adherence apparatus of Mr. de Bovet, which he calls the most remarkable magnetic device known; the present portion is devoted almost entirely to a description and discussion of the application to towing vessels by means of a chain, the adhesion between the chain and the driving machine being obtained by a magnetic device; only three metres of chain are required for the necessary adhesion, while with the old apparatus 40 metres were required; the system has been in use for 18 months and the results are so satisfactory that the vessels on the lower Seine are to be equipped with this system. Magnetic clutches are briefly referred to, a number of installations being cited in which they are used. In the continuation of the article in the issue of July 21, the apparatus for chain towing is described in detail, with the aid of a number of illustrations.

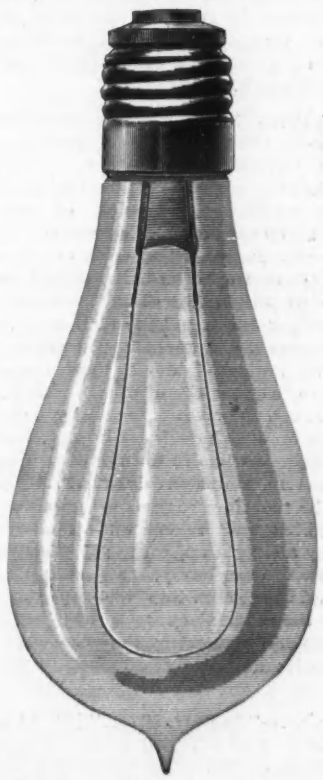
Efficiency of a Telephone Induction Coil.—A paper by Mr. Pierard is published in the "Bull. l'Assoc. de Montifiore," a full abstract of which is given in "La Lum. Elec.," July 14. The method of testing is to connect a microphone with a telephone first by means of one induction coil and then by means of another similar one whose secondary is connected with the secondary of another coil, the primary of which is connected with the primary of a third, the secondary of which is connected with the telephone; in the second case there are therefore three transformations, while in the first case there is but one; by means of switches the change from one set to the other may be made almost instantaneously; a given sound being produced in front of the microphone the distance of the telephone to the ear is increased until the sound is no longer heard; with these distances and certain simple formulas which he gives, the efficiency of the coil is calculated. He concludes that the efficiency does not vary appreciably with the charge and that it is somewhat less than 50 per cent. By increasing the number of coils until the sound disappears he calculates that the minimum amount of energy which actuates a telephone is equal to the $(0.44)^{19} = 0.00000016$ part of that in the primary circuit of the microphone.

Life Buoy.—According to the Lond. "Elec. Eng.," August 3, a German firm has devised a life buoy fitted with an electric lamp to be visible at night in water. It will sustain three persons at night in the water, weighs about one cwt. and contains an accumulator with gelatine material sufficient for an incandescent lamp for six hours; when hanging on the ship the current is switched off by the weight of the buoy, but when released the current is automatically switched on; the accumulator will last two months before it requires re-charging.

Detection of Liquor Frauds.—According to the Lond. "Elec. Eng.," Auugst 3, a French journal, in reply to an offer of an award of $10,000 by the French government to the inventor of a simple and sure method of determining fraud in the production of alcoholic liquors, suggests that a knowledge of the electrical conductivity with that of the density, might be a sufficient means if the liquor be brought to the temperature of melting ice.

A New Incandescent Lamp.

It has been shown at some length in the columns of The Electrical World, that the economical life of an incandescent lamp may not exceed 450 hours. It is now well known that after that time there is a steady decrease in the candle power, and, in some cases, even an increase in the amount of the electrical energy consumed; in other words, after 450 hours of use, the candle "burns at both ends," and the result is a decided loss in light and money to the consumer. It was proven that when lamps cost the consumer 35 cents each, it was a decided economy to smash the lamp after 450 hours of use, and that the desideratum now was either a cheaper lamp at the start or one that could be economically re-made. Dr. W. E. Forest, a physician of this city, has recently invented a lamp which, it is claimed, meets that want, as far as cheapness and effectiveness are concerned, the cost of the material in the lamp being a minimum.



Livgro Incandescent Lamp.

The illustration shows the lamp complete, from which it will be seen that it is handsome in appearance, not differing in shape or size from "all glass lamps." A mica disk fits into the shouldered neck of the bulb, through the centre of which the mount passes. Molten metal, whose co-efficient of expansion is practically the same as that of glass, is then poured into the neck, sealing the bulb, and at the same time firmly holding the mount in position. It is thus seen that this makes a metal stopper lamp.

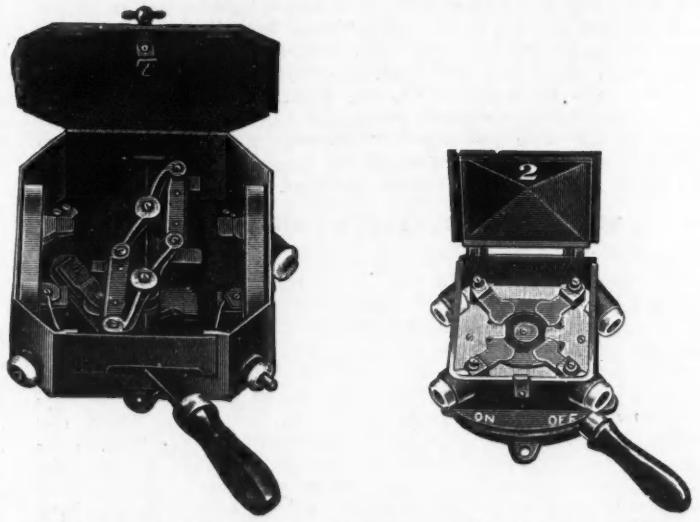
The advantages claimed for this lamp over others, are that it is handsome in appearance, not differing in shape or size from "all glass" lamps, and is more efficient. There is a double seal, consisting of a metal whose co-efficient of expansion is almost identical with that of glass, and a fusible, elastic cement reinforcing this metal, and no glass-blowing or skilled labor is required in making the mount or sealing the lamp.

A company of capitalists under the name of the Livgro Incandescent Lamp Company of Harrison, N. J., has been organized to exploit this lamp, and have fitted up a large factory at Harrison, N. J. Mr. C. F. Whittemore, formerly treasurer and superintendent of the Davis Lamp Company, of Springfield, Mass., takes charge of the factory. The president of the company is Mr. J. Livingston, the secretary and treasurer being Mr. Albert H. Gross, the son-in-law of Mr. James Seligman, the head of the well-known banking house of J. W. Seligman & Co. The executive officers of the company are at 50 Broadway, the salesrooms being in the Cable building, Broadway, corner Houston street, New York city.

High Tension Cut-Outs.

We illustrate several high tension cut-outs, manufactured by the Hope Electric Appliance Company, Providence, R. I., which unite the advantages of high insulation and quick-break with simplicity of mechanism and durability.

Fig. 1 shows a double-pole dead cut-out for primary alternating cir-



Figs. 1 and 2.—Primary Dead Switch and Arc Light Cut-Out.

cuits which is not only very rapid in breaking, but when open has a clear gap of more than an inch. The case is water-proof, so that the cut-out can be secured to a pole in the open air. A water-proof open

Fig. 3. Ceiling Hanger Arc Cut-Out.

air arc light cut-out is shown in Fig. 2, which is compact and has the mechanism insulated on a thick porcelain block. Fig. 3 illustrates a combined ceiling hanger and arc cut-out. This is secured to the ceiling by porcelain feet, and the mechanism is on a porcelain block, thus insuring a double insulation.

The Wenstrom Dynamo.

The two principal features of the dynamo we illustrate, manufactured by the Wenstrom Electric Company, Baltimore, Md., are the ironclad field magnets and the buried armature wires, the former of which are shown in Fig. 3 and the latter in Fig. 2, while the completed machine is shown in Fig. 1. The magnetizing coils are surrounded by iron in every possible direction, so that the iron core may collect all the lines of force from the coils, even those which are usually dissipated in the surroundings. It follows from this arrangement that the exciting power is less in this machine, all other things being equal, because the power is better utilized. Usually the space between the pole piece and the armature core must be sufficient, not only for the safe revolving of the armature at a high speed, but also for the conductors, which are wound transversely upon the core and in which the current is induced. This space introduces a high resistance to the magnetic lines of force, but in the dynamo illustrated the conductors are buried in grooves, or laced through holes transversely in the periphery of the armature, the distance between the pole piece and core being limited only to that small space required for the safe revolving of the armature. The resistance to the magnetic circuit is by this means reduced in a high degree, and it follows that the magnetizing power used for creating the necessary magnetism in the armature is also decreased.

The advantages of this type of dynamo are well brought out in a report by Gisbert Kapp, who, after a series of tests, writes as follows:

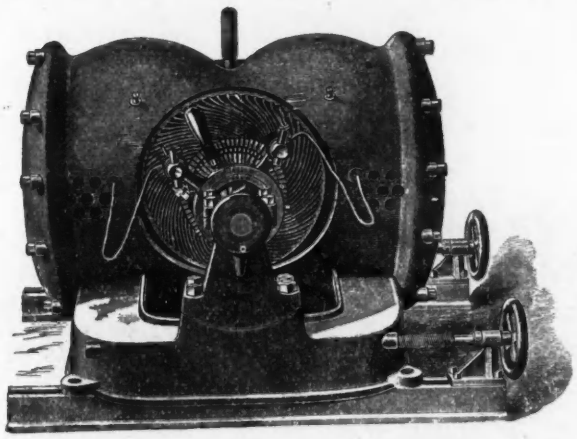


FIG. 1.—THE WENSTROM DYNAMO, SHOWING BRUSHES AND ARMATURE IN POSITION.

"The Wenstrom dynamo possesses many novel and remarkable points. It is very simply constructed and most substantially built, both as to electrical and mechanical details. Up to this time a machine has never been seen in this country which utilized all the magnetic forces as fully and undergoes so little loss of power as does the Wenstrom dynamo. It is impossible to utilize all such magnetic forces without the aid of two very essential points, which are the principal features of this machine. In all the best dynamos, as at present constructed, the manner of wiring the armature is such that it is impossible to bring the armature surface sufficiently close to the field poles to obviate the magnetic resistance, which it is very desirable to do. In

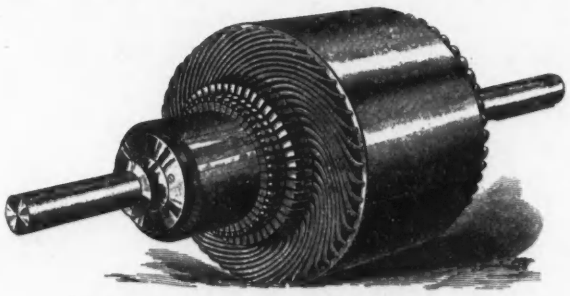


FIG. 2.—ARMATURE OF WENSTROM DYNAMO.

all the machines at present on the market, the old forms of field magnets have been strictly adhered to, and the currents produced by them generate magnetism in such a way that a large and valuable portion of it is generally lost. This, as will be readily perceived, it is very desirable to utilize, as, if it could be retained, more magnetism could be generated with less power. In the Wenstrom machine the desired end is attained by the peculiar construction of the field magnets and the cast-iron shell, which, while accomplishing the result demanded of it, also renders the dynamo more substantial and rigid in all its bearings. By this form the magnetic forces, which are generally lost in other makes of machines, are retained, while in the armature the two great obstacles are overcome by lessening the distance between the armature and the field, and by reducing the magnetic resistance to the core. The machine runs evenly and smoothly at extremely low speed. A careful examination of it will convince any one that it is the very best compared with other machines. In point of speed no machine can equal the Wenstrom, as it produces more current at low speed than any other can give at high speed. This dynamo has overcome some of the principal defects of other makes in speed, efficiency, weight and electrical and mechanical details." The compactness and convenient shape for handling of this dynamo, and the fact that the field coils are entirely

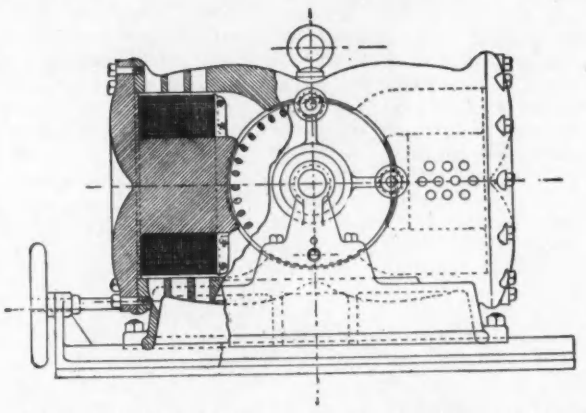


FIG. 3.—SECTIONAL END VIEW OF WENSTROM DYNAMO, SHOWING BEARINGS, COMMUTATOR, ETC.

contained within the iron body of the machine, obviate any risk of damage or breakage under ordinary circumstances in transportation or otherwise. All parts are made readily accessible for inspection or repairs. The armature can be taken out by simply removing one bearing. The field coils, which are wound on the heads of the machine, can very easily be removed by unbolting those heads.

Almost every dynamo of ordinary type is more or less subject to a wasteful and injurious heating in the iron core of the armature and pole pieces, due generally to the shape and the electrical conditions inherent in their design. This heating represents just so much energy absorbed or wasted in the production of a useless effect, and decreases more or less the efficiency of the machine. In some dynamos this heating is so intense after a long run as to imperil the safety of the insulation of the coils, and results in time in a rapid deterioration or destruction of the machine. The Wenstrom dynamo, on the other hand, can be run continuously for any length of time, and will show no such heating effect. This is due to the fact that from its construction there is an entire absence of wasteful Foucault currents.

New Electrical Devices.

Several patents have recently been issued to Mr. Henry B. Porter, of Porter & Co., Eighteenth street, New York City, for improvements in electrical apparatus, which involve some quite radical changes from current practice. The first relates to an electric bell, and consists first in the general arrangement and construction of the several parts so that greater simplicity and economy of construction are, it is claimed, secured, and second in the construction of the helix so that the necessary power can be obtained with considerable less current than ordinarily required.

Reference to the accompanying illustration will show the general plan of the bell. It will be seen that the core of the helix projects at both ends and that the armature is U-shaped, being pivoted between the sides of the frame and having its arms projecting over the extensions of the core. The core is made of iron tubing, the centre of which is filled with wood or other non-magnetic substance. Perhaps the chief merit claimed for this arrangement is that only one spool is required, and that this and the core, which may be found of ordinary soft iron tubing, are very easily made, and furthermore require a minimum of battery power to operate. The magnetic resistance of the circuit is very low and a more powerful pull for a given current is claimed. Another merit is that there being a comparatively small amount of iron in the core, the retention of magnetism is practically avoided, and for this reason the inventor intends to apply the same principle to telegraph instruments and other apparatus where residual magnetism is especially undesirable.

The other illustrations show a new type of motor, of whose practical success the inventor is very sanguine, claims being made especially for simplicity of construction and increased power. Fig. 1 shows a pair of these motors connected to a driving shaft and fly-wheel, and Fig. 2 is a vertical section of the same. Two helices are formed with their cores projecting at each end for the attraction of the armature, and are supported by a rod of non-conducting material passing through and extending within suitable seats in the frame to support the magnets in their proper position.

A double armature, consisting of two swinging frames pivoted to the upper end of the frame and formed in a manner to engage with the core at each end of the helix, and upon opposite sides, is applied to each magnet. One of the parts of the armature is of greater length than the other, and at or near its end engages with a horizontally arranged rod,

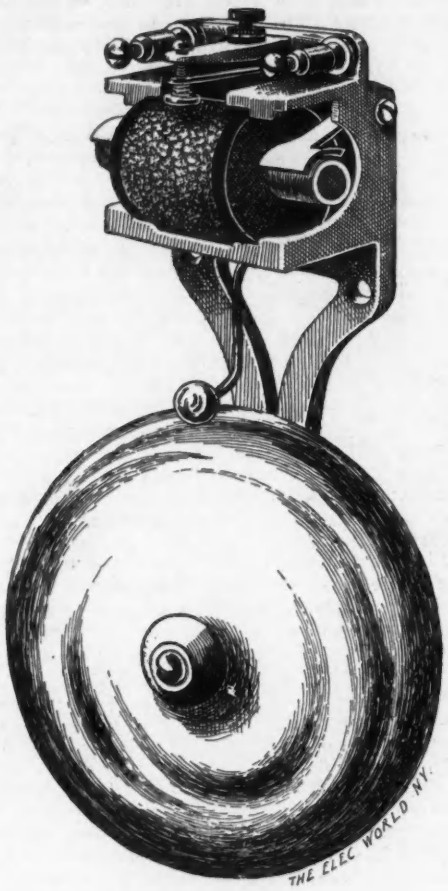


Fig. 1.—Improved Electric Bell.

which is loosely supported to slide in suitable bearings in order to bring the longer or principal armature better within range of the magnet. The longer the armature, the more leverage obtained. This engaging arm of the armature receives the combined motive power from the two parts of the latter when operated or attracted toward the core by means of a pivoted lever, which, at its opposite ends, is provided with anti-friction rolls adapted to engage with the corresponding face or surface of the two parts of the armature, in order that the same may be caused to move in unison when moving toward or from the core, and one be caused to move the other alternately as the same are moved in opposite directions, the short arm thus communicating its power to the opposite arm by means of this lever.

As shown in the illustration, a device is provided for automatically

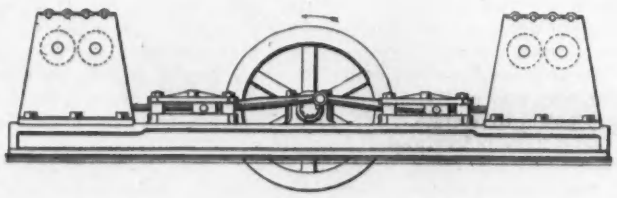


Fig. 2.—Porter Motor.

changing the current from one motor to the other in order that each may alternately draw the reciprocating connecting rods back and forth and rotate the connecting shaft. This device consists of a sleeve located upon the shaft in a manner to rotate with it, and also slide horizontally on it, the surface of which is divided into three sections, the central section being of non-conducting material and the end sections being formed of conducting and non-conducting material, as shown at each, forming half the circumference of the sleeve. The circuit from the battery is alternately changed from one motor to the other by means of two brushes forming one end of the circuit wires, which engage with the sleeve and alternately make and break the circuit as the conducting or non-conducting surface of the sleeve is in contact with the same during

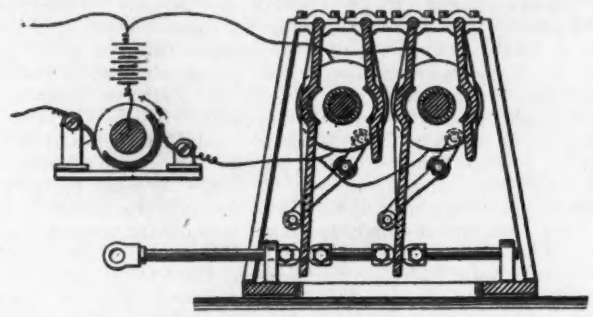


Fig. 3.—Porter Motor.

the revolution of the shaft. The operation of the shaft may be stopped or reversed by shifting the sleeve on the shaft to bring the proper surface into contact with the brushes, by means of a pivoted rod which engages therewith.

Automatic Oiling System.

A new automatic oiling system has been placed upon the market by the Wilson-Whiting-Davis Oiling Company, Broadway and Duane street, Mutual Reserve Building, New York city, which insures the oiling of machinery in a positive automatic manner, under a pressure sufficient to overcome all obstacles ordinarily encountered, and does away with all the manual labor usually required where hand-fed cups are used. At the same time a large saving of oil is claimed. The oil comes to the bearings perfectly clean, and the waste, which is very

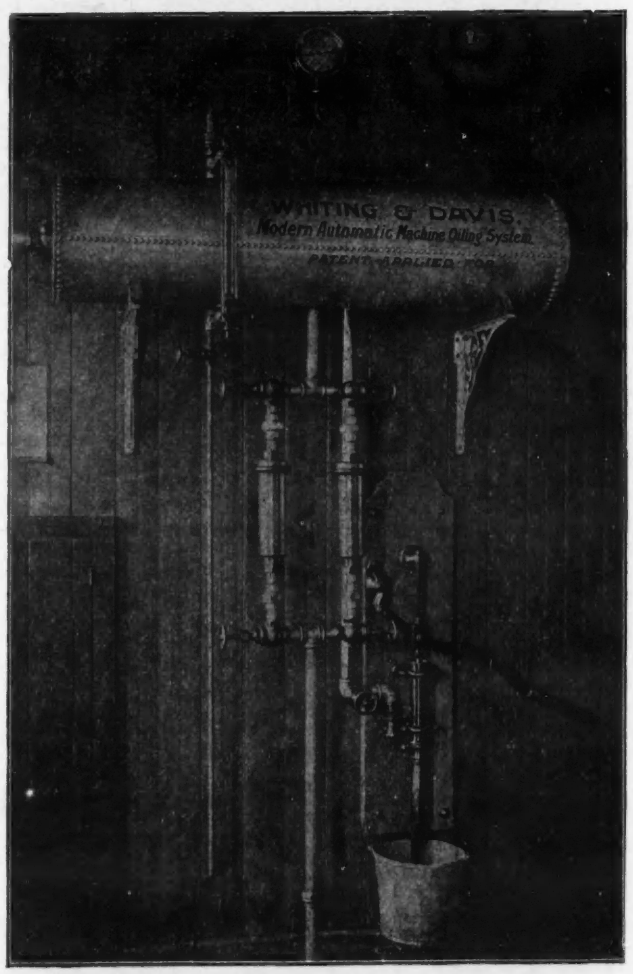


Fig. 1.—Automatic Oiling System.

small in amount, can if desired be returned to the reservoir by a gravity pipe system

The cups are of brass (nickel plated if desired) and are tested to stand any strain which can possibly be brought to bear upon them. Each cup is controlled by a separate valve and may be adjusted by a screw at top, so as to exactly regulate the feed, while permitting the instant flooding of any bearing if required. Each branch of piping and each separate machine is also controlled by a separate valve, hence, when a machine

is idle only the one valve requires closing and all cups on its line cease feeding.

The accompanying cuts illustrate in a general manner the system and its application to electrical machinery.

Fig. 1 shows the complete apparatus required to operate the system. This consists of an iron tank of any required capacity, into which the oil is pumped from barrel, main reservoir or filter, as the case may be. Pressure, to an amount depending upon the requirements of the plan, is then applied to the tank by the same pump (which is shown near the floor line), forcing the oil through the filters below the tank into the main line of piping, thence through concealed branches to the different machines and cups. The inlet and outlet pipes to tank are also controlled by valves, as already mentioned in describing cups and branches. When the number of cups exceed 125, or machinery is on different levels, an automatic compressor is provided to further insure the constancy of the pressure.

Two filters are provided on the main supply pipe so as to admit the use of one in case of the other needing repairs or cleansing. This main outlet inside the tank extends several inches above the bottom, to prevent the entrance of any foreign substance into the main feed line; when the gauge indicates the presence of such substances or water, the same may be drawn off by a sediment cock and branch, shown below tank. The tank may be placed at any point in the engine or oil room. The gauge and register may be on wall in sight of the engineer and the pump lever convenient to his hand. The variation in pressure, due to the gradual emptying of the tank, is so slight as to demand but a minute or so of attention twice a day.

The piping may be of iron or brass as required, and on fancy plants may be bent, thus doing away with many connections and couplings. This piping is so arranged as not to interfere in the least with the operations of the machinery.

Upon electrical machinery, proper insulators are provided and placed. Fig. 2 shows the system as applied to an arc light dynamo. One of the best illustrations of the efficiency of this system is the very complete installation in connection with the plant in the Equitable Building, New York City.

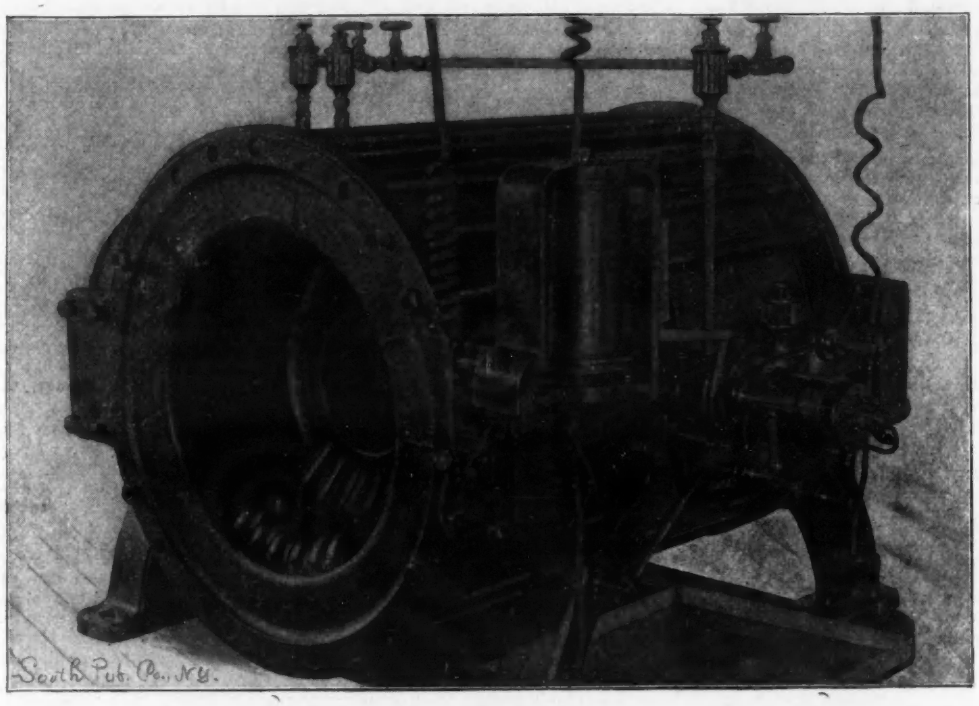


FIG. 2.—OILING SYSTEM APPLIED TO DYNAMOS.

Storage Batteries of Large Capacity.

The New York Edison Electric Illuminating Company has contracted with the Electric Storage Battery Company of Philadelphia for a large storage battery installation.

The installation will consist of 150 elements of chloride accumulators, type G, 41 plates, having a capacity of 8,000 ampere hours at 150 volts, normal rates, or a total capacity of 1,200 kw. hours.

The installation will be furnished with the most modern and complete appliances for the control and operation of the battery, and everything possible will be done to make it a model, and at the same time the most modern and complete battery plant ever installed.

The battery is to be installed immediately to be ready for the heavy winter load. This installation possesses more than usual interest on account of its large capacity and its evidence of the recognition on the part of American companies of the value of a storage battery plant. The New York Edison company has been using a battery of 2,000 ampere hour capacity for more than a year and has reached the inevitable conclusion that an auxiliary accumulator plant is desirable. This is practically the first instance where accumulators have been employed for this purpose on any considerable scale, and it is gratifying that the Edison company has given the contract, after the most thorough investigation here and abroad, to an American company in preference to a foreign firm.

Incandescent Lamp Adjuster.

We illustrate a very simple lamp adjuster, manufactured by Gibbs & White, 8 Hayward Building, Rochester, N.Y. As will be seen, it is not controlled by weight or friction, but by a positive double catch engaging on the rim of the reel. The catch is secured to the lamp cord by a fibre hook, thus insuring perfect insulation. It can be attached to a lamp by any one in a few seconds, and adjusts up to six fee. The weight is only two and a quarter ounces, and the catch disk 2 inches in diameter. The small spring used is merely for reeling the cord, and does not support any weight.

LAMP ADJUSTER.

New Book.

ELECTRIC LIGHT INSTALLATIONS. Vol. II.—Apparatus. A Practical Handbook. By Sir David Salomons, Bart., M. A. Seventh Edition, revised and enlarged. London: Whittaker & Co. 1894. 318 pages, 296 illustrations. Price, $2.25.

This is the second of three volumes of a series on electric light installations, of which Volume I. is confined entirely to the subject of accumulators and Volume III. deals more particularly with the methods of working. The present volume relates to apparatus, though some information in regard to their use is included. The first chapter is principally devoted to gas engines, in regard to which much practical information is given, derived from the author's experience with his extensive private plant at Broomhill; a few pages relate to steam and oil engines and considerable space to engine accessories, as oil economizers, counters, speed indicators, etc. The next chapter describes and illustrates a number of types of dynamos, and a lengthy chapter on measuring instruments follows. Chapter IV. is on electric governors for maintaining a constant potential or current, of which two types are described. In Chapter V. switches and switchboards are dealt with, and the following chapter illustrates many forms of fuses, cut-outs, connectors and minor apparatus. Some pages on arc lamps make up Chapter VII., while the succeeding chapter is on practical applications, and from the numerous cuts and little descriptive matter looks suspiciously like padding.

While a greater portion of the book is purely descriptive, yet practical information of direct application is scattered everywhere throughout its pages, and we can unhesitatingly recommend these volumes to the owners and electricians of isolated electric lighting plants as the best of which we know for their purposes.

Financial Intelligence.

The Electrical Stock Market.

New York, August 18, 1894.

DUN'S REVIEW, of August 18, has the following: The new tariff bill, if signed by the President, as expected, provides a definite basis for business. No supplemental legislation is thought possible until next year at least. Large improvement has been expected from any settlement, the more because of a vast amount of business deferred from week to week in the hope of more definite conditions. The rush of such business, or even a part of it, might easily double transactions for a time. It is not to be overlooked that the effect of new duties upon many branches of industry and trade is problematical, and may be determined only after some months of experience, and meanwhile the serious injury to corn and some other conditions exercise a restraining influence. While it is not wise to look for a great "boom," there is warrant for a reasonable and prudent hopefulness.

GENERAL ELECTRIC has reached a higher quotation this week than it has the last six months. It closed to-day at 43 5-8. As already stated in these columns the burning of the Siemens & Halske plant gave a spurt to the stock, and the statements of increasing business and the bull feeling has continued to advance General Electric. General Electric bonds have also crept up until they are now quoted at 92, and preferred stock is now sold at Boston at 42½.

WESTINGHOUSE ELECTRIC. July orders were the largest in the history of the company and footed up $980,000. This amount includes the contract of equipment for the United Electric Light and Power Company of New York, amounting to several hundred thousand dollars. Shipments from the company's factory in July were between $500,000 and $600,000, and collections were of about the same amount, 80 per cent. of them being in cash. It is now thought that common stock dividends will be passed until the company is housed in its new works at Brinton. The board of directors will meet during the coming week, and probably some action will be taken on the dividend subject. Westinghouse common closed two points below last week's figures, while the preferred advanced 1½ per cent.

BELL TELEPHONE has had a week of fluctuations and closes at about the same figures it did a week ago. One day the stock dropped off two points, but as there were no new developments in the company's affairs, the drop was only attributed to a dull market.

FORT WAYNE STOCK is ruling a little stronger than it has, and the New York office reports a fair all round manufacturing business. Current rumor has it that the Fort Wayne is intending to enter the railway field as an active competitor of General Electric.

THE NEW ENGLAND TELEPHONE AND TELEGRAPH COMPANY paid a quarterly dividend of $1.00 per share on August 17. This Company is planning to do a considerable amount of underground work in the various cities of Massachusetts during the current year, and it has gained such a reputation in this class of work that members of the Louisville, Ky., city goverment have recently been inspecting the New England's plant and underground wire system at Boston.

AMERICAN DISTRICT TELEGRAPH stock has been more active than usual during the week and is offered at 45. The company paid a quarterly dividend of 1 per cent. August 17.

WESTERN UNION TELEGRAPH continues in activity and appreciation. It has made a net gain during the week of 1½ points and has sold as high as 90.

NEW YORK EDISON ELECTRIC ILLUMINATING is making slight advances. That this stock does not appreciate in accordance with its intrinsic value is said to be largely due to the number of foreign stockholders who are inclined to let go their holdings at any bad financial news from American soil. The stock is now ranging around par, but this is below the quotations of the illuminating properties in the larger cities. The higher rate of dividend paid in some of the cities of course makes better prices for the stock, though the New York compares well with all of the stocks, paying the same rate it does. The coupons of the first mortgage bonds, due September, will be paid by the New York Guaranty and Indemnity Company.

EDISON ELECTRIC ILLUMINATING COMPANY OF BROOKLYN.—A statement was published during the week saying that this company's receipts, owing to economy in the consumption of light, had fallen off from $3,000 to $5,000 per month. This gives an erroneous impression of the true status of the company. There is always less light used at this time of year, and, with the prevailing dull times, the company's business is naturally less than it would be in midwinter. Compared with last year, however, the July net earnings for 1894 show an increase of $3,976, and the net earnings for the first six months of 1894 are $83,206.99, an increase of $15,687.99. The company has now 1,000 arc lights in operation for street lighting in Brooklyn.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
*Edison Electric Ill., New York	100	98½	100
* " " " Brooklyn	100	101	103
* " " " Boston	100	120	121
" " " Chicago	100	135	145
* " " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2⅞	3
General Electric	100	43	44
Interior Conduit & Ins. Co.	100	45	55
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	33	34
" " " pref	50	52	53
BONDS.			
Edison Electric Ill., New York	1,000	107	108
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	92	93
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	199	200
*American District Telegraph	100	—	45
American Telegraph & Cable	100	89½	90
Central & South American Telegraph	100	105	110
Commercial Cables	100	120	145
*Erie Telephone	—	45¾	46
*New England Telephone	—	68	69
Gold & Stock Telegraph	100	100	102
*Mexican Telegraph	100	190	200
*Western Union Telegraph	100	89¾	89⅞

*Ex. div.

New Incorporations.

THE CROWN POINT ELECTRIC COMPANY, Crown Point, Ind., capital stock $10,000, has been formed for operating light, heat and power plant in Crown Point, Ind. The incorporators are Geo. K. Wheeler, E. S. Tice, O. W. Olsen.

THE LACKAWANNA VALLEY TRACTION COMPANY, Scranton, Pa., capital stock $400,000, has been incorporated to construct and operate passenger railways by motors, cables or other machinery. L. A. Watres, L. Amerman, P. S. Page, all of Scranton, are the organizers.

THE PITCAIRN, WILMERDING & BRADDOCK STREET RAILWAY COMPANY, Pittsburgh, Pa., capital stock $21,000, has been formed to construct and maintain an electric railway. The promoters are G. W. Barricklow, G. H. Garber and H. L. Castle, all of Pittsburgh.

THE SOLANO ELECTRIC LIGHT COMPANY, Benicia, Cal., capital stock $10,000, has been formed to do a general lighting and power business, using electricity and gas. T. McKay, M. Chisholm, M. McArthur, P. Fry, Benicia, and G. Frame, Elmira, Cal., are interested.

THE SANDUSKY VALLEY ELECTRIC RAILROAD COMPANY, Upper Sandusky, O., capital stock $10,000, has been formed to build and operate a railroad from Marion to Port Clinton. The interested parties are J. Q. Wirick, R. R. Dumm, F. E. Dumm, G. H. Roppold and T. Carroll.

THE ELECTRIC ADVERTISING COMPANY, San Francisco, Cal., capital stock $100,000, has been formed to do advertising by means of electrical and other devices. F. Brandt, E. L. Waibel, O. Waibel, G. A. Paul, G. L. Schneider, C. E. Fisher and A. R. Paul, San Francisco, are interested.

THE BOSTON AUTOMATIC FIRE ALARM COMPANY, Portland, Me., capital stock $250,000, has been formed to manufacture and deal in electric, fire and burglar alarms. The incorporators are E. S. Cowles, Jersey City, N. J.; Edwin Sheafe, Boston, Mass., W. O. Underwood, Lynn, Mass.

THE OHIO METAL COMPANY, Norwalk, O., capital stock $25,000, has been formed for dealing in and manufacturing metal goods, manufacturing gas and electric fixtures, etc. The incorporators are E. F. Rowley, W. H. Price, Jas. G. Gibbs, Geo. T. Thomas, N. O. Allen, F. A. Powers, R. K. Rood.

THE AKRON INSULATOR & MARBLE COMPANY, Akron, O., capital stock $20,000, has been formed for manufacturing and dealing in insulators, tubing, electrical machinery, appliances, goods, specialties, etc. The incorporators are Jas. P. Loomis, Albert L. Bouman, Adelbert L. Daniel, Jas. P. Hemphill, Samuel C. Dyke.

THE GILMORE WATER & ELECTRIC LIGHT COMPANY, Independence, Ore., capital stock $30,000, has been formed to furnish water for domestic and other purposes, electric light, heat and water, or electric or other power. The incorporators are L. C. Gilmore, J. S. Cooper, J. A. Veness, D. B. Taylor, I. M. Vanduyne, A. S. Locke.

THE NEW YORK STANDARD CONSTRUCTION COMPANY, New York, capital stock $50,000, has been incorporated by Eugene Berry, Rutherford, N. J.; R. Krouse, Santiego; M. Sugarman, Brooklyn, and W. T. Zandt, New York, N. Y., to construct electric light plants and railways as well as to do various other kinds of construction work.

THE SAVOY ADVERTISING-VENDING MACHINE COMPANY OF NEW JERSEY, Jersey City, N. J., capital stock $200,000, has been formed to make, use and deal in all kinds of mechanical and electrical machines, instruments, etc. The incorporators are John I. McDavitt, of Pompton, N. J., Geo. F. Rundle, Sparkhill, N. Y., Jerome Bradley, N. Y. City, N. Y.

THE WESTMINSTER & UNION MILLS ELECTRIC RAILWAY COMPANY, Westminster, Md., has been organized by T. H. Shriver, of Union Mills, C. E. Stewart, W. B. Thomas and others of Westminster, and Frank Brown, of Baltimore, president of the Baltimore Traction Company. This company proposes to construct an electric road from Baltimore to Gaithersburg.

THE CO-OPERATIVE ELECTRIC RAILWAY COMPANY, Chicago, Ill., capital stock $1,000,000, has been formed to acquire, sell, lease or operate railways, to buy, use or operate franchises for the same, to manufacture, sell or operate patents, protecting electric railways, equipments, etc. The incorporators are: Morris S. Evinger, Chas. E. Nurnap, Isaac T. Dyer.

THE LANCASTER RAILWAY CONSTRUCTION COMPANX, Trenton, N. J., capital stock $100,000, has been formed to build, construct and furnish material for the construction of electric and steam railroads. The incorporators are Henry Baumgardner, Michael Reily, Geo. N. Reynolds, John E. Hubley, Frank H. Steacey, David B. Shenk, Lancaster, Pa., Hugh E. Grilley, Allentown, Pa., Theo. Mace, Trenton, N. J.

Special Correspondence.

New York Notes.

New York, August 20, 1894.

MR. BRAINARD RORISON was in the city last week and left on the steamship Paris, on Wednesday, for a visit to his family in France, his children being in school there.

NEW ENGLAND NOTES.

BOSTON, AUGUST 18, 1894.

REYNOLDS T. WHITE, widely know as the inventor of White's elevated railroad system, died at his home in Medford last week.

THE W. S. HILL ELECTRIC CO., Boston, Mass., reports business greater than ever in its history. This factory is kept busy at nights upon orders.

MR. FRANK S. DE RONDE, the popular general sales agent of the Standard Paint Company, of New York, was a Boston visitor this week, favoring this office with a call.

MANAGER EDWARD H. OAKES, of the Lynn Electric Company, has been arrested on the charge of having set fire to the Strout building on July 21, which nearly resulted in the loss of five lives.

MR. W. C. BRYANT, of the Bryant Electric Co., Bridgeport, Conn., was in Boston this week. He was accompanied by his wife, but notwithstaning this fact he could not help looking after business just a little. This is one of his characteristics.

MR. GEORGE L. WILEY, eastern manager of the Standard Underground Cable Company, of Pittsburg, Pa., looked in upon us this week, his countenance beaming with its usual cheerfulness. We can't remember to have ever seen him otherwise, which fact, coupled with his indomitable energy, has won for him extraordinary business success.

MR. D. A. ANDREWS, JR., AND MR. C. B. PRICE, treasurer and general manager respectively of the Pettingell-Andrews Company, of Boston, are enjoying their vacations this summer in a very sensible and business-like manner. One of them can always be found at the office looking after the rapidly in creasing business of the company, and yet every other week each takes a few days' outing and enjoyment.

MR. GEORGE E. RUSSELL, bookkeeper and cashier for the Pettingell-Andrews Company, of Boston, is at present enjoying his vacation in New Hampshire. He certainly deserved it, and we trust it will abound in uninterrupted pleasures and enjoyments. Mr. Russell has been connected with the Pettingell-Andrews Company for nearly five years, during which time he has always been faithf l in the discharge of his duties, has made hosts of fri nds, and enjoys the entire confidence of the officials of the company.

WEYMOUTH, MASS., RAILWAY ENTERPRISE.—It is stated that the directors of the Rockland & Abington Electric Street Railway Company have offered to give up a franchise granted them by the selectmen of Weymouth to extend their tracks from South Weymouth to East Weymouth to a company of Weymouth citizens who desire to construct a road. At East Weymouth the new company proposes to connect with a line which is to run to Nantasket Beach.

NEW STREET RAILWAY.—A corporation to be known as the Milton & Boston Street Railway, is being formed at Milton with a capital stock of $50,000. The company will construct and operate by electricity a street railway from East Milton to Mattapan, a distance of about four miles, and connect with the Dedham street railway at Mattapan. A preliminary organization has been made with these directors: Albert A. Brackett, John R. Lawrence, D. J. Brown, William H. Rice, of Milton; John A. Duggan, Thomas H. McDonnell and Walter P. Pinel, of Quincy.

THE AMERICAN ELECTRICAL WORKS, of Providence, R. I., has issued invitations for its sixteenth annual Rhode Island Clam Dinner, which will be held next Saturday, August 25, at Haute Rive. This is one of the events always heartily welcomed by the electrical fraternity, as a good, solid day of pleasure is assured and enjoyment and good fellowship reigns supreme. Old friends meet again who might not otherwise, and new friends are always made—facts which have endeared genial Eugene F. Phillips to all who have ever enjoyed his kindness and hospitality.

THE PERKINS ELECTRIC SWITCH MANUFACTURING COMPANY, of Hartford, Conn., is making important and extensive additions to its factory, which is being increased to the height of three stories, the building to be of brick, lighted on all sides, amply provided with elevators and all modern sanitary appliances for a first-class workshop. The extension of its plant is for the purpose of getting its various departments together and affording ample accommodations for its growing business. It is expected that the new building wil be ready for occupancy October 1st.

OPPOSED TO ELECTRIC LIGHTS.—A large portion of the summer residents at Marblehead, Mass., do not want electric lights there. The town, at the annual town meeting, voted to purchase an electric lighting plant to light the streets and public buildings, and as the Neck is included in the town, enough poles and wire were ordered to equip it with lights. The contracts were signed and the work of erecting the poles began. Now comes this unlooked for opposition, and the committee is in doubt what to do. If a majority of the property owners do not want the lights the committee will not insist upon erecting them. One of the reasons they advance is that the electric glare will obstruct the view of the harbor and the ocean.

HANOVER, N. H., STREET RAILWAY.—The stockholders of the Hanover Street Railway Company held their first meeting at Union Hall, Assinippi, last evening to form a permanent organization. A code of by-laws was adopted, and the following Board of Directors elected: Charles H. Killam, Frederick B. Jacobs, Frank S. Alger, Jedediah Dwelley, Charles L. Stevens, Herbert L. Curtis and Frederick H. Curtis. The directors elected Charles H. Killam president, Frederick B. Jacobs, clerk, and Frederick H. Curtis, treasurer. These officers were chosen a committee to confer with the Rockland & Abington Street Railway officials in regard to the extending of that road to the Hanover line, and also to negotiate with the Abington & Rockland Electric Light and Power Company.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., reports the shipment last week of a car load of electrical apparatus, consisting of one 250-light dynamo and ten 3 h.p. Manchester type slow speed motors, with special starting boxes, to the Massachusetts State Insane Asylum at Danvers. The motors will be used for operating ventilating fans throughout the building, the whole installation being in the hands of G. M. Angier & Co., of Boston, New England contractors for Mather apparatus. The company also reports the sale, through Harry S. Smith & Co., of Philadelphia, of two 45 kw. direct connected dynamos for the Bartram apartments of that city. These dynamos are to be of the new Mather multipolar type, directly connected to Woodbury engines, and when completed will be one of the finest direct connected plants in Philadelphia.

News of the Week.

TELEGRAPH AND TELEPHONE.

LOCKPORT, N. Y.—Mr. Edward F. Griffin is organizing a telephone company, intending to install a plant of 300 telephones. He is in the market for material for its construction.

BALTIMORE, MD.—The City Subway Commission met to pass upon plans, etc., submitted by Engineer Hill to place the wires of the police and fire alarm telegraph systems underground. It is contemplated to make the City Hall the centre of the conduit system. The Council has appropriated $100,000 for the work of burying the wires.

ELECTRIC LIGHT AND POWER.

LEECHBURG, PA.—The city will soon enjoy the electric light.

WAUKON, IA.—The council has been petitioned for a franchise to supply the town with electric lights.

TARRYTOWN, N. Y.—St. Teresa's Roman Catholic church is being renovated and will be lighted by electricity.

READING, MASS.—At a special meeting held in Reading it was voted to establish a municipal lighting plant at a cost of $50,000.

PHILADELPHIA, PA.—A two-story structure is to be added to the Howard Hospital. It will be heated by steam and lighted by electricity.

NEWARK, N. J.—The Newark Electric Lig ht & Power Company has begun the work of erecting a large power house, 75x72, to cost $12,000.

SALT LAKE, UTAH.—The City Council has under consideration the proposition of L. C. Trent & Co. to put in an electric plant at a cost of $100,000.

LITTLE ROCK, ARK.—The Brown Electric and Machinery Company has closed a contract for an electric light plant to be installed at Lockhart, Tex.

WAUSAU, WIS.—The council has entered into a contract with the Wausau Elecric Light Company for a period of five years, at the rate of $80 per light.

WAUKON, IA.—Mr. M. B. Hendricks has been granted the exclusive right to erect and maintain an electric light plant in Waukon for a period of seven years.

OGDENSBURG, N. Y.—B. C. Algie and others are advocating the purchase of a municipal plant and desire information as to apparatus from manufacturers.

HARTFORD, CONN.—The Housatonic Electric Light Company has been organized. Milo B. Richardson, of Salisbury, has been elected president of the company.

HOT SPRINGS, ARK.—The Hot Springs Electric Light Company is to put in a new 1,500-light alternator, slow speed preferred. W. M. Wilson is the superintendent.

BETHANY, MO.—The Franklin Electric Company, of Kansas City, has been awarded the contract for the erection of an electric light plant and water works for the city.

CLEVELAND, O.—The Cleveland General Electric Company has amended its charter, changing the name of the corporation to that of the Cleveland Illuminating Company.

WICHITA FALLS, TEX.—The Consolidated Engineering Company, St. Louis, Mo., has been awarded the franchise for the establishment of an electric light plant and water works system.

JACKSONVILLE, FLA.—The city council has instructed the city attorney to draw up an ordinance authorizing the board of public works to purchase and erect an electric light plant at a cost of $75,000.

WYOMING, PA.—At a regular meeting of the Wyoming Borough Council, an ordinance was presented and read for the increase of the borough indebtedness to the amount of $15,000 for the erection of an electric light plant.

WATCH HILL, R. I.—There has been some talk during the week about lighting the place with electricity. It is probable that the Pawtucket Valley Street Railway Company will put in an electric lighting plant next year.

CLEVELAND, O.—The new building to be erected by the New England Company will be provided with a separate electric plant. The contract for the building has been let to Norcross Bros., Worcester, Mass. Many parts of the work will be sublet.

OTSEGO, MICH.—Otsego is to have electric lights. George C. and B. A. Nevins have purchased the Pine Creek flouring mill, and will put in a dynamo and bring the electricity here, a distance of one mile, and will distribute it over the village as wanted.

WORCESTER, MASS.—A business block will be built by the State Mutual Life Insurance Company at Maple and Main streets. A large area will be left open on which it is possible that after the block is completed the land may be utilized for a power house and electric plant.

MANLIUS, N. Y.—An electric light franchise has been granted by the trustees of the village of Manlius to Edward Kanaley, who is organizing a company to put in an electric light plant at Edwards Falls, and furnish light for East Syracuse, Fayetteville, Eastwood Heights, Manlius and other villages.

THE CONSOLIDATED ENGINEERING COMPANY, St. Louis, Mo., has closed a contract with the city of Paducah, Ky., for a municipal arc street lighting plant. Standard Electric Company's dynamos and Hamilton Corliss engine will be installed, the city of Paducah to furnish real estate and buildings. There will be 120 2,000-c. p. arc lights in the streets.

EAST PROVIDENCE, R. I.—A plant to manufacture electricity is being located on what is known as Bower's Cove, on the lower part of the East Providence side of the river. The device is the invention of Mr. John Wild, of this city, and application has already been filed for a patent. Mr. Charles A. Brown is associated with him, and they are organizing a stock company.

The Electric Railway.

CHARLESTON, S. C.—Julian Fishurn is seeking a franchise from the council for an electric road.

ROME, N. Y.—The Rome City (N. Y.) Street Railway Company will adopt electric motive power on its system.

GREENVILLE, TEX.—The city has granted a franchise for an electrical railroad. The mayor can give particulars.

BENTON HARBOR, MICH.—$1,300 bonus was raised by citizens to extend the electric street railway one mile to the eastern city limits.

NEWARK, N. J.—A new electric railway will be built through Kingsland streets, Franklin avenue and Centre street, to Washington avenue.

KEY WEST, FLA., is to have an electric railway. J. J. Philbrick has obtained a charter and will build eight miles of road and equip it for electric cars.

COLUMBUS, GA.—The Columbus Railroad Company, operating dummy and horse-car lines, will, it is expected, soon take steps for changing to electric power.

HAVANA, CUBA, offers an excellent opening for an electrical railway. Electric cars would prove a paying investment with the gay and pleasure-loving Cubans.

LITITZ, PA.—A franchise has been granted the Lancaster and Lititz Electric Railway Company to lay tracks and operate an electric railway in the borough of Lititz.

WILLIAMSPORT, PA.—Residents and land owners in Nippenose Valley are agitating the project of constructing an electric line from Nippenose to Williamsport.

NEW ORLEANS, LA.—Engineer Brown has completed specifications for the work necessary to change the lines of the St. Charles Street Railroad Company to electric power.

COLUMBUS, GA.—The North Highlands Railroad Company has been granted a franchise for the extension of its line, and engineers are now at work surveying the route.

PATERSON, N. J.—Sheriff Rea says that the promoters of the Paterson Company have already signified their intention of extending the tracks of the North Main street line to Readville.

MILFORD, N. J.—Milford's council has granted the right of way for the electric road, and it may cross the river at Milford and get to Carpenter's Point, on the Jersey side of the river.

JOPLIN, MO.—The Joplin Electric Railway Company proposes to extend its line to Galena, Kas., a distance of eight miles. The Joplin Electric Railway Company is owned by St. Louis capitalists.

SWARTHMORE, PA.—Winfield Johnson and Benjamin F. Wickersham have secured the contract to build the Philadelphia & Delaware County Electric Railway from said place into and through Media.

MILFORD, CONN.—The application of J. S. Brown et al., of Milford, for a charter to build an electric road, is a substantial evidence that Bridgeport and New Haven are soon to be connected by the trolley.

WEST ORANGE, N. J.—The Suburban Traction Company has offered to grade the proposed street to be known as Meadowbrook Lane, if the Board would give it a franchise to operate an electric railway thereon.

ST. AUGUSTINE, FLA.—An officer of the St. Augustine Electric Railway states that the road would surely be started within thirty days. The starting point of the road will be at the intersection of King and St. George streets.

ROYERSFORD, PA.—Royersford is the objective point of two trolley lines, namely, the Pottstown line and one from the county seat, but whether either will be given the franchise to this borough entirely remains to be determined by the town council.

HAVERHILL, MASS.—Charles Corliss, of Haverhill, Mass., declares that at the next session of the New Hampshire Legislature he will ask for a charter for an elevated or an electric railway, which will begin at Haverhill, Mass., and extend to Nashua.

PAWTUCKET, R. I.—At the meeting of the Lincoln town council a petition was presented from the Moshassuck Railway Company, asking for the right to extend their line and to operate the cars with electricity. Superintendent Clark may be addressed.

WAPPINGER'S FALLS, N. Y.—A road connecting Wappinger's Falls with Fishkill will next be constructed. M. Hinckley, the president of the road, it is definitely stated, is one of the representatives of certain influential capitalists who are putting the enterprise through.

CHEVY CHASE, MD.—The Chevy Chase & Kensington Railroad Company has been organized to build an electric railway from the present terminus of the Rock Creek Railway to Kensington. Oliver R. Harr is president, Alfred Ray, vice-president, and W. H. Walker, secretary.

ATLANTA, GA.—Mr. Walter H. Lenhart, Southern agent for the Standard Electric Company of Chicago, presented a petition asking for the right to put electric light wires, erect poles and put in conduits along Whitehall, Pryor, Loyd, Broad, Decatur and Peachtree streets for the purpose of furnishing light and power. The petition was referred to the electric light committee.

Trade and Industrial Notes.

MESSRS. H. B. COHO & COMPANY, 203 Broadway, did a very quick piece of work last week. They received an order for a 500-light Mather generator at 4 o'clock one afternoon, telegraphed to their factory at Manchester, Conn., and next evening at 6 o'clock the dynamo was carrying its full rated load.

MR. S. W. RUSHMORE, 126 Liberty street, has increased his facilities at his factory in Jersey City for the manufacture of his high tension arc lamps, by the addition of several special and expensive machines. He has discontinued the manufacture of the constant potential arc lamps, having sold the patent rights to the General Incandescent Arc Light Co.

W. S. BELDING, Chicago, the well-known manufacturer of commutators, has recently formed a company to be known as the Belding-Hayward Company, with Mr. E. L. Hayward as president. The new concern will occupy the offices of Mr. Belding, 48, 50, 52 North Clinton street, and will push the sale of the specialty more extensively than ever before.

THE NATIONAL CONDUIT MANUFACTURING COMPANY, Times Building, New York, has just closed a contract with the Boston Electric Light Company, of Boston, Mass., for all its subway work for this year, and has also contracted with the Nebraska Telephone Company for all the conduits for the Lincoln subway, which is to be built this year.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, has received some pretty good orders for I. X. L. triple braid wire during the last week, among the number being one for thirteen miles and one for ten miles, large sizes. This wire is coming into prominent notice in the West, being already a favorite in the East, and the Metropolitan Electric Company carries a large supply on hand to enable it to fill orders without delay.

THE WATERTOWN STEAM ENGINE COMPANY, Watertown, N. Y., among recent contracts, reports two 100 horse-power compound condensing engines, complete, with boilers, condensers, pumps and heaters, to the village of Napoleon, O. Also two direct connected high speed automatic engines to the St. Denis Hotel, New York, and one 250 horse-power slow speed automatic engine to the Firmenich Manufacturing Company, of Marshalltown, Ia.

MR. HENRY HANDSHY, electrician of the San Antonio Electrical Supply Co., of San Antonio, Texas, has secured the contract for the wiring and completion of all electrical work of the Opera House at San Luis Potosi, Mexico. The building is owned and controlled by the Mexican government, and when finished (about November, 1894) will cost a trifle over $1,000,000. The building covers an entire block and has been under construction for over five years. There are to be 600 incandescent lights, besides a number of arc lamps.

J. ELLIOT SHAW & Co., 632 Arch street, Philadelphia, have issued a 144 page catalogue of household electrical supplies, containing illustrations and prices of almost every conceivable form of house goods. The last 16 pages are devoted to general remarks on batteries, electromotive force, resistance, etc., directions for setting up and maintaining batteries and gas-lighting apparatus, wiring estimates for annunciators, burglar alarms and electric gas-lighting, diagrams of bell circuits and much other information of value to electricians.

THE CHICAGO OFFICE of the Ball Engine Co., Erie, Pa., in the Rookery Building, have had, even in these depressing times, a fair amount of business. Among recent sales are the following: Peninsula Electric Light and Power Co., Houghton, Mich., one 350 h. p. tandon compound engine; Hotel Newcombe, Quincy, Ill., one 60 h. p. engine; Howe Pump and Engine Co., Ladd, Ill., one 50 h. p. engine; Industrial Home of the Blind, Chicago, one 80 h. p. engine, direct connected to general electric dynamo; Norton Bros., Maywood, Ill., two 150 h. p. Cross compound engines.

SIEMENS & HALSKE ELECTRIC COMPANY, Chicago, has, since the fire, closed six contracts for various classes of machinery, of which the two most important are the Hotel Savoy, New York, for a large lighting plant, and Franklin MacVeagh & Co., in Chicago, for a power transmission plant. The works of the Grant Locomotive Company have been leased, and are now in operation as an electrical manufacturing plant. Several 1,000 h. p. dynamos were commenced August 13, and before the end of the month 1,000 men will be at work in the new shops on orders aggregating 20,000 h. p. of electrical machinery.

THE GILLILAND TELEPHONE COMPANY, of Chicago, is meeting with good success in the introduction of its telephone. The instrument is made in a substantial manner and is artistic in form, consisting of a magneto mounted on a backboard, with desk, bi-polar magneto transmitter, and telephone receiver with cord, and is sold outright at a fair price. Its central office and exchange system for towns and small cities is complete and comprehensive. The president, Mr. W. H. McKinlock, and the general manager, Mr. J. J. Nate, have spent the greater portion of their lives in telephone and kindred electrical interests, securing therefrom broad and valuable experience, which are very necessary factors to the advancement of telephone work.

EDWARD P. THOMPSON, M. E., 5 Beekman street, New York, announces that he has associated with himself Professor William A. Anthony, whose professional record is so well known that it is almost superfluous to refer to it. He was professor of physics at Cornell University for 15 years, where he planned and equipped the physical laboratory building, and organized and had charge of the department of electrical engineering, and is a past president and member of the American Institute of Electrical Engineers and Fellow of the American Association for the Advancement of Science. Since the time of his resignation from Cornell University, Prof. Anthony has had much experience in designing and building apparatus and machinery for electric lighting and power transmission, and as a consulting electrical engineer and expert in technical and patent matters. For the greater portion of this period he was engaged as the consulting electrician of the Mather Electric Co. He is the author of many papers presented before technical societies and in scientific periodicals, and, with Prof. Brackett, of Princeton, of a text-book of physics. Few men in America are as competent to undertake all classes of electrical expert work, both commercial and scientific.

THE PLANT OF THE MATHER ELECTRIC COMPANY, covering a number of acres, is situated in Manchester, Conn. (three hours on the train from either New York or Boston), directly on the main line of the New York & New England Railroad, which, together with a sour track running directly into their erecting shop, allows the company to load heavy generators directly on the cars and gives them the best of facilities. The company recently completed an extension to its plant in the form of an iron building, 500x50 feet, for an erecting shop, constructed by the well-known Berlin Iron Bridge Company, of East Berlin, Conn., and fitted with a fifty-ton Shaw electric traveling crane, which, together with a large amount of new machinery which the Mather Company has recently installed, consisting of heavy planers, boring mills, radial drills, lathes, etc., enables the company to handle large generators up to 500 kilm., and larger in capacity. The Mather Electric Company is making a specialty of both belted and direct connected work especially for railway and power purposes. Its facilities for testing generators, from the smallest to the largest, under most severe conditions, are second to none, its steam plant being especially arranged and

adapted for this purpose. The Mather Company already contemplates another extensive addition to its plant in the early future, to accommodate large work and new battery boilers and engines, especially for testing this class of apparatus. The entire plant of the Mather Company is operated by electric motors, sizes varying from five to fifty h. p., which system of transmission and sub-division of power have been found exceedingly satisfactory and economical in the operation of the works.

Business Notices.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

A PROFESSOR OF MECHANICAL AND ELECTRICAL ENGINEERING, one who is a good teacher and who can successfully direct the mechanical work in the shops, is wanted immediately at Delaware College, Newark, Del.

THE CORRESPONDENCE SCHOOL OF TECHNOLOGY, Cleveland, Ohio, has engaged Mr. J. N. Dodd, a graduate of, and last year Fellow in Mathematics at Princeton, as instructor in mathematics. The school reports growth, and has received many lettters from its students commending the work.

OPEN AND CLOSED CIRCUIT CELLS.—The Hayden carbon porous cup No. 1; the Hayden carbon porous cup No. 2 cell; a Leclanche clay porous cup cell; a standard Fuller cell; a No. 2 Fuller cell; a single cylinder carbon cell; a double cylinder carbon cell. All reliable and efficient, and at prices lower than ever. THE HAYDEN-BOOKER MANUFACTURING COMPANY, 2140 DeKalb street, St. Louis, Mo.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 31, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

594,305. ARC-LAMP POST; Richard B. Bowker, New York, N. Y. Application filed June 22, 1894. The combination in an arc lamp support of a hollow post or standard, two arc lamps supported at the upper part and a resistance at the base thereof; the said lamps and resistance being connected in series and the said resistance and circuit conductors being wholly inclosed within said post.

524,343. ELECTRICAL CONDUCTOR; Edwin D. McCracken, Alpine, N. J. Application filed November 29, 1893. An electrical conductor having a covering consisting of a strip or strips of paper, composed of pure vegetable fibre, applied in its unchanged fibrous condition, the paper forming of itself an insulating covering and being dry and coated to render it practically anhydrous.

524,357. ELECTRIC ARC LAMP; Otto Hans Swoboda, New York, N. Y. Application filed July 19. 1893. In an electric arc lamp, the combination with a shunt across the arc nominally controlling the feed mechanism, of a second shunt across the arc controlling a nominally open circuit including in series a resistance and a coil about the feed controlling shunt magnet whereby when the arc is broken the lamp resistance is thrown around the arc and energizes the magnet which controls the operation of the feed mechanism.

524,361. METHOD OF AND APPARATUS FOR DETECTING AND MEASURING INFLAMMABLE GASES; Benjamin C. Tilghman, Jr., Philadelphia, Pa. Application filed March 14, 1893. In an apparatus for detectiug the presence and amount of inflammable gases and vapor in the air, the combination of a source of electrical supply, a circuit connected with the source of the electrical supply, a conductor of relatively high resistance arranged in said circuit and adapted to change its resistance under the influence of the electric current and any imflammable gas or vapor in the air, and an independent indicator for showing such changes of resistance.

524,366. ELECTRIC RAILWAY SYSTEM; Theodore B. Wilcox and Henry Wilcox. Application filed August 1, 1893. A surface plate for electric railways, provided with a box in which a magnetic contact-maker is adapted to reciprocate, in combination with a magnet, operating outside the plate, for causing the reciprocation of the said contact-maker, the exposed portion of said plate consisting of parts made respectively of magnetic and of non-magnetic material insulated from each other.

524,367. ELECTROMAGNETIC CONTACT-MAKING DEVICE FOR ELECTRIC RAILWAY SYSTEMS; Theodore B. Wilcox and Henry Wilcox, Newark, N. J. Application filed August 1, 1893. An electro-magnetic contact-making device, having its contact surfaces surrounded at the time of contact only by soft rubber whereby any water which may have accumulated upon the co-operating contact will be rendered harmless against causing injurious leakage.

524,368. ELECTRIC RAILWAY SYSTEM; Theodore B. Wilcox and Henry Wilcox, Newark, N. J. Application filed August 16, 1892. In an electric railway system, a series of exposed magnetic surface plates arranged along the railway track, in combination with a motor car carrying an endless chain, a portion of which is in proximity to the said chain, the said magnetic devices being just as far apart along the length of the said chain as the said surface plates are distant from each other.

524,373. REGULATION OF DYNAMO-ELECTRIC MACHINERY; Edward M. Bentley, Boston, Mass. Application filed December 26, 1890. In a motor regulator the combination with a circuit closer of a choking coil adapted to be included in the motor circuit, means for automatically cutting out the said coil and additional means for varying the counter-electro-motive force of the motor.

524,374 BATTERY-CHANGER FOR ELECTRIC LIGHTS; Charles Bernhardt, Chicago, Ill. Application filed November 23, 1891. The combination with a normally closed circuit, a battery lying therein, and a movable device operated by the breaking of the circuit of a second battery, and a switch operated by said movable part, and adapted, when so operated, to connect one of said batteries with said circuit.

524,376. COMPOUNDING MOTOR-GENERATORS; James Burke, Schenectady, N. Y. Application filed June 5, 1894. In combination, a motor-generator having its armature motor-winding in series in the primary circuit and its field-magnets in shunt to the motor winding, and a second or auxiliary counter electro-motive force machine having an armature distinct from that of the main machine, such armature being in series in the primary circuit, and its field magnets having a winding in shunt in its armature and a differential series winding in the secondary circuit.

554,378. SYSTEM OF ELECTRICAL DISTRIBUTION; Thomas A. Edisou, Llewellyn Park, N. J. Application filed December 6, 1886. In a system of electrical distribution, the combination of a source of current of high tension, two feeding circuits extending therefrom, each including the primary coils of a tension reducing converter, a circuit including translating devices in multiple series, a conductor from the secondary of one converter extending to said translation circuit, a conductor from the secondary of the converter in the other feeding circuit, a conductor extending from between the translating devices to one joining the two secondaries, and means for separately regulating the two feeding circuits.

524,381. SYSTEM OF POWER DISTRIBUTION AND REGULATION; John W. Gibboney, Lynn, Mass. Application filed October 21, 1893. In a system of power distribution the combinatiou with two or more independently operated plants, such as mills or factories, of a dynamo electric machine installed at each of said plants and adapted to co-operate therewith, and an electric circuit connecting said dynamo electric machines in parallel.

524,382. RHEOSTAT; Albert B. Herrick, Schenectady, N. Y. Application filed May 22, 1893. In a rheostat, a fuse included in the circuit of current-carrying capacity greater than that of the resistance wire and adapted to break the circuit when the heat of the bos is excessive.

524,383. BUS-BAR SWITCH FOR CENTRAL STATIONS; Albert B. Herrick. Schenectady, N. Y. Application filed June 9, 1894. A system of bus-bar switches for a central station comprising bus-bars, switches adapted to connect the bus-bars in different combinations, switch-boards located in different combinations, switch-boards located in a gallery, and mechanical connections between the switches on the bus-bars and the apparatus located upon the switch-boards in the gallery.

524,384. DOUBLE-THROW SNAP-SWITCH; Edward M. Hewlett, Schenectady, N. Y. Application filed July 2, 1894. A double-throw jack-knife switch, comprising a central blade, two outer blades, and a spring connected from one of such outer blades to the other, the outer blades having cut-away portions pivoted to the central blade and adapted to make positive contact therewith after a definite arc of movement.

524,385. CONTROLLER FOR ELECTRIC MOTORS; Joseph H. Jenkins, Lynn, Mass. Application filed February 3, 1894. A controller for electric motors comprising an actuating shaft or spindle mounted in suitable bearings, a circuit modifying device carried by said shaft, and means for removing such device from the shaft, without removing the shaft from its bearings.

524,387, TELEPHONE-SWITCH; Harry T. Johnson, Elizabeth, N. J. Application filed February 1, 1894. In a telephone apparatus, the combination of a circuit controlling device for making and breaking the circuit through the signalling apparatus, a local circuit, independent of the line circuit, for actuating said circuit controlling device, and a switch or circuit controller actuated by the movement of the telephone receiver to make and break the local circuit.

524,388. ELECTRIC SEARCH LIGHT; Edward R. Knowles, Middletown, Conn. Application filed January 9, 1893. In a search-light, the combination with the drum, of a diverging lens, and an electric motor supported on the drum, and moving therewith and arranged to operate the lens.

524,396. CONTROLLER FOR ELECTRIC MOTORS; William B. Potter, Lynn, Mass. Application filed December 21, 1893. The combination in an electric controller, of a switch having a multiplicity of contacts, and a blow-out magnet having a common pole piece extending from a common core to points adjacent to the several circuit-breaking points of the switch.

524,407. ELECTRIC MOTOR; William L. Silvey, Dayton, O. Application filed March 2, 1894. A field magnet for electric machines consisting of two wire-wound electro-magnetic rings, having pole pieces of alternate polarity projecting from their sides between the coils of the rings, the two rings united together by rods of the pole pieces of the two rings.

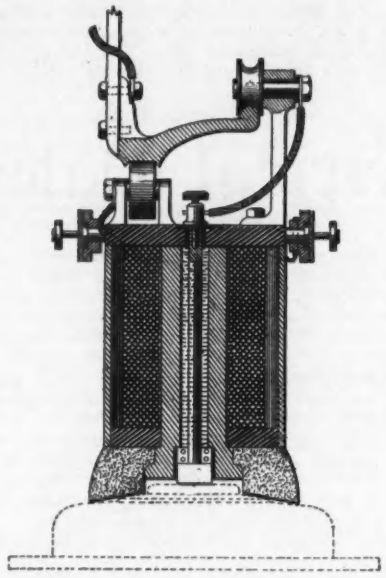
524,426. ELECTRO-MAGNETIC MOTOR; Nikola Tesla, New York, N. Y. Application filed October 20, 1888. The combination in an electro-magnetic motor with a rotary armature of field cores of different magnetic susceptibility and energizing coils thereon connected in series and adapted to be connected with a source of alternating currents.

524,462. ARC LAMP; Robert Drysdale, Everett, Mass. Application filed January 14, 1893. An arc lamp having a movable rack carrying a carbon, gear mechanism provided with a fan and engaging said rack, a movable frame in which said fan is mounted and an electro-magnet in circuit with the lamp for governing the position of said frame, a movable arm for engaging said fan, said arm being moved into engagement with said fan by means of a solenoid in circuit with the lamp and out of engagement with said fan by means of a spring-impelled lever.

524,467. INSULATING TURNBUCKLE; Henry Herbert Luscomb, Hartford, Conn. Application filed June 5, 1894. An insulator provided with a connection having applied to the free end thereof a bushing connection of non-oxidizable material fused to the metal of material of similar nature fitted to said bushing.

524,480. TELEPHONIC SYSTEM; Henry A. Chase, Boston, Mass. Application filed April 16, 1894. The combination with an electric circuit, of a telephonic transmitting apparatus provided with a mouthpiece and adapted to be included in said circuit, a circuit controller governing the said transmitter circuit, and a movable cover or shield, co-operating with the mouthpiece of the said transmitter and operatively connected to the said transmitter circuit controller, and provided with an arm having a hook to support the receiver.

524,524. TELEPHONE TRANSMITTER AND RESISTANCE VARYING MATERIAL THEREFOR; Frank R. Colvin, New York, N. Y. Application filed October 10, 1893. A resistance varying material for telephones, consisting of a mass of granules of carbonized petroleum residuum.

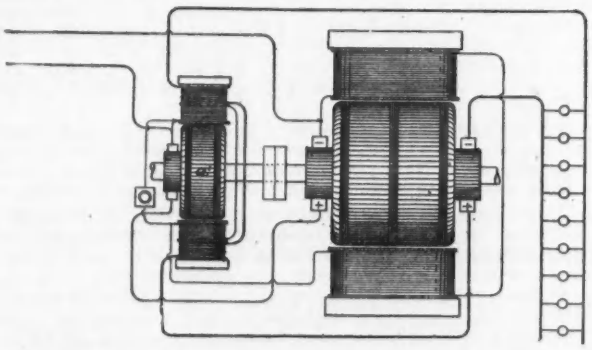


No. 524,367.—Electromagnetic Contact Making Device.

524,533. DYNAMO-ELECTRIC MACHINE OR ELECTRIC MOTOR; Alonzo B. See and Walter L. Tyler, Brooklyn, N. Y. Application filed May 10, 1894. A dynamo-electric machine or electric motor provided with a box-shaped field-magnet frame having interiorly projecting field-magnet cores, a removable cover on one side of the frame, lateral openings to permit the introduction and withdrawal of the armature, and standards for the armature bearings below said openings.

524,534. ALTERNATE-CURRENT MOTOR; William Stanley, Jr., Pittsfield, Mass. Application filed April 13, 1892. An alternating current motor, consisting of independent field-magnets or sets of poles adapted to be energized by alternating currents of different phase, in combination with an armature and coils thereon within the influence of each field, the coils in one field being connected with or closed through coils in the other field distorted or displaced with reference to the first.

524,541. PNEUMATIC CONTROLLER; Edward H. Dewson, Jr., Lynn, Mass. Application filed April 11, 1893. In a pneumatic controller, a cylinder, a piston therein geared to the switch or other device to be operated, a valve controlling the admission of air or other fluid under pressure to said cylinder, a stop adapted to control the movement of said switch, and a common lever which first operates said valve and then actuates said stop to control the movement of the switch.



No. 524,376.—Compounding Motor Generators.

524,542. PNEUMATIC CONTROLLER· Edward H. Dewson, Jr., Lynn, Mass. Application filed July 13, 1893. A pneumatic device comprising pressure cylinders and transmitting cylinders substantially as described, pistons, in said pressure cylinders respectively connected to pistons in said transmitting cylinders, non-elastic or incompressible fluid acting as the transmitting medium between said transmitting cylinders, and a cock for controlling the passage of said fluid from one of said transmitting cylinders to another.

524,548. AUTOMATIC ELECTRIC SIGNALING DEVICE; Edward Adolph Hermann, St. Louis, Mo. Application filed April 16, 1894. In a device of the class described, a supporting box, a rock-shaft, mounted in said box, a semaphore mounted on said rock-shaft, slides mounted upon said semaphore, and a rod connecting said slides to the said box at a point eccentric to the axis of said rock-shaft.

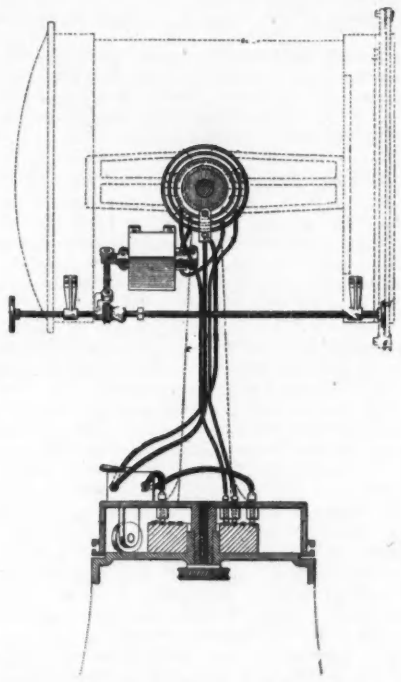
524,615. MOTOR-REGULATOR; Joseph F. Sheahan, New York, N. Y. Application filed May 28, 1894. In an apparatus of the kind described, the combination with the motor, the single rheostat arranged in the motor circuit, and the automatically operated weighted rheostat arm, of the pull knob operatively connected with the arm to raise it against the weight and thereby render it operative by hand as well as automatically.

524,625. TELEGRAPHIC TRANSMITTER; Frank F. Howe, Marietta, Ohio. Application filed January 15, 1894. A transmitter comprising a plurality of transmitting devices arranged with two or more of said devices in a series, an operating mechanism adapted to actuate each series at a different speed, and a circuit which is opened and closed by said devices.

524,630. AUTOMATIC CIRCUIT-BREAKER, Anatole C. Charles, Portland, Me. Application filed April 14, 1894. In a circuit-breaker for broken electric wires, a metallic bridge supported in a suitable case and insulated therefrom, a pivoted carrier mounted in said case, a circuit breaking rod having an inclined end set in said carrier and insulated therefrom, the inclined end of said carrier having a plate pivotally attached thereto and adapted to rest loosely upon said metallic bridge, but adapted to be disconnected therefrom by the breaking of the wire.

524,636. INDUCTION COIL; Charles L. Jaegerm, Maywood, N. J. Application filed January 18, 1894. The combination with an induction coil, having connection with two separate generators of electricity, of a device for automatically switching in the auxiliary generator on the failure of the primary generator.

524,646. ELECTRIC HEATER; Charles H. Newbury, St. Paul, Minn. Application filed April 18, 1894. A support for the incandescent filament of an electric heater, composed of two similar parts, each consisting of a bar having a cross-head, the edge of which is provided with half-round seats adapted to register with those in the similar part to form substantially circular openings for said filaments, and perforated supports adapted to receive and hold said parts in juxtaposition.



No. 524,388.—Search Light.

221,656. ELECTRICAL STORAGE BATTERY; Burton C. Van Emon, San Francisco, Cal. Application filed November 6, 1893. In an electric accumulator or storage battery, electrodes or plates protected on their sides and edges from the liquid solution of electrolyte by means of an elastic non-conducting and non-porous grid or form-separating frames or forms also of non-conducting non-porous material, having ribs or ledges that bear upon the walls of elastic material that contain and confine the active material so as to expose but one side of the latter to the electrolyte.

524,659. INSULATOR; George A. Winslow, Pittsburgh, Pa. Application filed December 8, 1893. An insulating body, an oil cup co-operating therewith and means for supporting said oil cup directly from said insulating body.

524,664. ELECTRIC BELT; Flora A. Brewster, Baltimore, Md. Application filed June 2, 1894. In an electric belt, a support containing an electric battery formed of two pieces of felt having secured to one side thereof a series of copper plates and to the other a series of zinc plates, the two series being electrically connected by metallic strips which pass through the pieces of felt.

524,672. TROLLEY-WIRE SWITCH; John M. Anderson, Boston, Mass. Application filed April 26, 1894. In a support for electric conductors the combination with side walls forming a grove, channel or way for the reception of the electric conductor, of a locking dog or cam supported in said grove between the said side walls, and a clamping bolt extended into a threaded socket in the side walls to operate.

524,684. INSULATING TURN-BUCKLE; Louis McCarthy, Boston, Mass. Application filed June 13, 1894. An insular comprising two shells having oppositely projecting connections placed within the same and insulating therefrom, a turn-buckle device having opposite ends of the same placed within the respective shells and insulated from each of the said connections by an interposed mass of insulating material.